DOCUMENT RESUME

ED 216 892 SE 037 820

AUTHOR Jansson, Lars C.
TITLE A Survey of Secondary Mathematics Teacher Training Practices in West Germany and the Netherlands.
PUB DATE May 82
NOTE 107p.

EDRS PRICE MF01/PC05 Plus Postage.
DESCRIPTORS Cross Cultural Studies; Educational Research; *Foreign Countries; Higher Education; International Studies; Mathematics Curriculum; Mathematics Instruction; *Mathematics Teachers; *Preservice Teacher Education; *Secondary School Mathematics; Surveys; *Teacher Education Programs
IDENTIFIERS *Mathematics Education Research; Netherlands; West Germany

ABSTRACT

The survey, conducted during 1979-80, focused on practices in the professional component of preservice teacher education in West Germany and the Netherlands. The report is divided into four major sections: (1) the structure of the questionnaire (included in the appendix), (2) the West Germany results, (3) the Dutch results, and (4) concluding remarks. A brief description is given of the educational system in each country. Data are then presented and discussed on such factors as number and type of mathematics courses, student teaching practice, activities in mathematics education courses, topics dealt with in the school classroom, topics and activities used in methods classes to help teachers think about classroom instruction, and theoretical bases. In the brief concluding section, several similarities and differences occurring between programs are noted. For instance, analysis/calculus, linear algebra, and geometry receive considerable attention in both countries, while the stress on computer science varies. Concern was expressed by respondents from both countries about the role and nature of the school practicum. (MNS)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED216892

A SURVEY OF SECONDARY MATHEMATICS TEACHER TRAINING PRACTICES IN WEST GERMANY AND THE NETHERLANDS

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

✓ This document has been reproduced as received from the person or organization originating it.
Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

Lars C. Jansson
Faculty of Education
University of Manitoba
Winnipeg, Canada R3T 2N2

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY
Lars C. Jansson

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

May 1982

SE037820

PREFACE

This project, which began as a matter of personal interest, soon showed itself to be of interest to others as well. It is probably impossible to do full justice to the topic without experiencing in depth the attitudes and orientations developed within each teacher training program. Nevertheless, the factual information gathered here may be of use and interest to mathematics teacher educators.

The project would not have been possible without the assistance of people too numerous to mention, but I would especially like to thank Carlo Hollman, Albert Koldijk, and Dick Ronda of Groningen (Netherlands) and Heinrich Besuden of Oldenburg (West Germany) for their helpful comments on both the questionnaire and drafts of this report.

TABLE OF CONTENTS

Preface ii

Introduction 1

I. Structure of the Questionnaire 3

II. The West German Results 5

Summary 42

III. The Dutch Results 44

Summary 83

IV. Concluding Remarks 84

References 85

Appendix A: The Questionnaire

Appendix B: Cover Letters

INTRODUCTION

NACOME (1975, Chapter 4) suggested that the dominant feature of mathematics teacher education (in the United States) is the absence of hard data concerning programs and practices. I suspect that this applies more widely than just to the United States. There are of course glimpses of light (e.g. Aviv and Cooney, 1979; Rasing, 1979), but more is needed.

Teacher education in secondary mathematics certainly varies from country to country, state to state and institution to institution, and I am convinced, from individual instructor to individual instructor. Nevertheless there are commonalities, particularly when we restrict the discussion to the professional training of mathematics teachers. A survey, the results of which will be presented and discussed here, was carried out during the academic year 1979-80 while the author was on sabbatical leave in the Netherlands. The genesis of the idea for such an investigation was really nothing more than personal interest. However, I believed from the beginning that this sort of information would be both useful and interesting to others in the field of training secondary mathematics teachers. The response to certain items in the questionnaire, the personal letters and telephone calls from a number of respondents, as well as personal conversations suggest that I was not wrong in my belief.

The investigation focussed on practices in the professional component of preservice teacher education. By "professional" is meant those courses and experiences relevant to becoming a mathematics teacher as opposed to a mathematician or some sort of general educationalist. I side with Freudeuthal (1978) here that teachers teach something, namely mathematics and that this fact governs and guide much of what else goes on. By professional, I also include student teaching practice. The mathematics subject matter component and the education "theory" courses will be touched on briefly, but they lie outside the major focus. Great number of writers (e.g., Smith 1976, 1971; Rasing, 1979;...) agree that an adequate teacher education program provides for

1) training in pedagogical concepts and principles
2) teaching skills in the subject matter
3) subject matter knowledge - Mathematics
4) developing relevant attitudes

The last one of these is not always made explicit.

The goals of teacher training programs are necessarily related to the values and goals of the entire educational system of which they are a part. It is up to others with more expertise in international and comparative education to pursue such comparative relationships in more depth. It will be necessary in this report to give some brief descriptions of the Dutch and West German educational systems, and comparative statements with the North American situation will be inevitable. Where statements in this area go beyond fact they are the responsibility of the investigator alone. I trust that my facts are correct.

This complete report will be divided into five major sections with subsections, as follows:

I. The structure of the Questionnaire
   - A. Rationale
   - B. Organization
   - C. Assumptions
   - D. Limitations

II. The West German Results
   - A. Brief description of educational system
   - B. The Sample
   - C. Results
   - D. Conclusions

III. The Dutch Results
   - A. Brief description of the educational system
   - B. The sample
   - C. Results
   - D. Conclusions

IV. Concluding Remarks

I. THE STRUCTURE OF THE QUESTIONNAIRE

The questionnaire attempted to survey practices intended to serve those program elements identified in the Introduction. The first three are certainly dealt with directly in questionnaire items, while concern for relevant professional attitudes expressed itself in responses to more open ended questions. The attitudes of the teacher trainers are only briefly hinted at in such responses.

Except for page 1, the questionnaires for West Germany (D) and the Netherlands (NL) were the same. Items on this page dealt with personal and institutional identification (items 1-5 and 10-19), school organization, and levels of teacher certification (items 6-14). Copies of the actual questionnaire can be found in the appendix, but I will here identify and briefly describe the various sections.

Section A, personal and institutional identification. Some basic definitions of terms used in the questionnaire are provided, along with instructions for institutions operating more than one program.

Section B, items 6-19, concerns basic institution and program size and structure.

Section C and D, items 20-32, deal with the minimum number of semester hours required in various areas of mathematics. An evaluative question as to the adequacy of the mathematics program for the teaching level is asked.

Section E, items 33-47, asks for the school subjects, if any, which may be chosen as a second teaching area.

Section F, items 48-62, concerns general background work required in education in a nonsubject matter context.

Section G, items 63-72, student teaching practice, the duration and time in program are considered. Items 73-74 ask for time of occurance of first course in mathematics teaching methods and text material used in such courses.

Sections H-N deal with mathematics education, i.e. that professional training aspect of the program directly related to teaching mathematics.

Section H, items 75-84, is a checklist of activities which are part of the respondents mathematics education courses.

Section I, items 85-94 and K, items 108-113, is a list of topics dealt with in the school classroom. Asked is the amount of emphasis given to in methods classes, how to handle these topics.

Section J, 95-107, is a check list of topics and activities often used in methods classes to help teachers think about their classroom instruction.

Sections L and M, items 114-152, is an attempt to determine what writers are being referred to in order to develop a theoretical basis for dealing with various aspects of a teacher's work. The specific topics are drawn from sections I and J.

Section N contains open ended evaluative items concerning the program.

Section O items deal with the background credentials expected of an instructor in mathematics education.

Section P is a series of open ended questions dealing with inservice training opportunities and/or requirements.

One assumes that those who took time to complete the questionnaire did their best to truly represent their particular programs. Furthermore, since respondents were responding to items in a foreign language, the investigator hopes that his own language was not too ambiguous. An underlying assumption is that the teacher education components indicated in the Introduction and the resulting questionnaire structure do in fact describe some, if not all, important aspects of a mathematics teacher training program.

There are obvious limitations to a project of this kind. The survey itself was completed in the spring of 1980 and inevitably changes have occurred since that time. Indeed, many responders indicated in their returns that changes were under way. The sample of mathematics teacher educators was small, but hopefully representative of training programs. Comparisons between the two countries are tenuous at best without further investigation. Institutional autonomy as well as different degrees of governmental centralization contribute to this state of affairs.

II. THE WEST GERMAN RESULTS

West Germany operates under a federal system which gives authority over educational matters to the states (Länder), of which there are eleven:

1. Baden-Würtemberg
2. Bayern (Bavaria)
3. Berlin
4. Bremen
5. Hamburg
6. Hessen
7. Niedersachsen (Lower Saxony)
8. Nordrhein-Westfalen (North Rhine-Westphalia)
9. Rheinland-Pfalz (Rhineland-Palatinate)
10. Saarland
11. Schleswig-Holstein

Under such a system there are naturally differences in educational structures which influence teacher education. Differences due to history, culture and religion are also part of the picture. In elementary and secondary education, there is a great deal of commonality: Secondary school begins with the fifth year of schooling (about ages 10-11). At this point the student must choose between:

1) Gymnasium - The academic program for students bound for university and higher level professional training. This program requires nine years on top of the elementary school (Grundschule). Roughly 20% of the students follow such a program, admissability depending on ability and past performance.
2) Realschule - a middle level program of six years duration designed for students headed for middle level professional training, technology positions, and administrative positions in government, business, and industry.
3) Hauptschule - is a five year vocationally oriented program. It can lead directly to the world of work, or in some cases to further vocational training.

The first two years in each type of school are intentionally an orientation period - sometimes (e.g., in Niedersachsen) even a comprehensive "orientation school" of its own - to find out the appropriate secondary school for the pupil. This is done by differentiated teaching and testing.

There are now also comprehensive schools (Gesamtschulen) in a few localities in a few states. Such schools have all three programs under one roof with possibilities for interprogram shifts and changes. Such programs have not been entirely popular particularly with parents of children of Gymnasium ability.

Teacher education programs tend to train teachers for only one or two of these types of schools, with Gymnasium teaching equated much more with university level in terms of social prestige attached to the position. Gymnasium teachers have traditionally, and still are, educated at the university in a program very heavy in mathematics. In some states teacher training levels still follow the prevalent school types:

1) Grund- und Hauptschule
2) Realschule
3) Gymnasium
4) Berufsschule (Vocational schools)
5) Sonderschule (Special schools)

In others these have been consolidated to three levels:

1) Primarstufe
2) Sekundarstufe I
3) Sekundarstufe II

Training for the lower levels may take place at a Pädagogische Hochschule (PH) or at a university, depending on the particular state. The relation of these two types of institutions varies by state and is in flux. Some PHs have been integrated into universities, at least one has become a university in its own right, and still others remain as high level independent teachers' colleges. The term "university" will be used here to refer to the traditional university, the Technische Hochschule (TH), as well as the newer Gesamthochschule (GHS). Unless it has become a fully integrated part of a university, a PH will be considered here as a separate sort of institution devoted solely to teacher training. Further detailed data on the organization of teacher training by Land is given in Studien- und Berufswahl 1980/81 in the section dealing with the "Lehramt." The lexicon provided by Eggerer and Feurer (1975) is a useful guide through the technical terminology of educational organization.

The questionnaire used in this survey was sent to a sampling of mathematics teacher educators. The sample was selected in two ways: First the recommendations by two colleagues of those whom they thought knowledgeable and likely to respond were included. This group included representatives of both types of institutions and several states. An approximately equal number was randomly selected from a listing of mathematics educators in a manner so as to give some representation to all states and a balance to school types. To this select sample of 39 was sent the questionnaire and cover letter (in English). These appear in the appendix. Two were returned by the post and presumably 37 reached their intended recipients. These 37 represented state and school types as shown in Table DO: | in each of the two institutional groups as well as overall the return rate was approximately 50%.

The numbers in the table indicate the number of responding persons compared to questionnaires sent, not the number of programs for which completed questionnaires were received. Recipients were requested to complete a questionnaire for each program of study with which they were involved. Thus 19 respondents gave replies for a total of 28 different programs.

Table DO

Numbers of respondents by "Land"

State	University	Päd. Hochsch.	
1. Baden-Würtemberg	0/2	2/3	
2. Bayern	2/3	-	
3. Berlin	0/1	1/1	
4. Bremen	1/1	-	
5. Hamburg	1/1	-	
6. Hessen	1/2	-	
7. Niedersachsen	2/2	2/3	
8. Nordrhein-Westfalen	1/5	3/5	
9. Rheinland-Pfalz	2/3	0/1	
10. Saarland	1/1	0/1	
11. Schleswig-Holstein		0/2	
	11/21	8/16	19/37

The data from the objective response items of the returned questionnaires was analyzed using the SPSS CROSSTABS program. As well as the overall tallies for each item a cross tabulation was made by institutional type. The number of questionnaires per state did not support a state analysis.

In the questionnaire the following were presented after getting the initial biographical information:

Definition: The terms *student program* and *program of studies* will be used to refer to the total course of study at the tertiary level which leads to certification to teach mathematics in secondary schools.

N.B. If, in your institution, there are different programs of study leading to different levels of certificate, please complete a separate questionnaire for each level. Additional copies of the questionnaire may be obtained by photocopying this one or requesting copies from the investigator.

The above definition was assumed throughout. Items 7-14 differed by country and appeared on page 1; all subsequent items were identical for the two countries. For the German questionnaires, analysis was carried out for two categories of institution: 1) Pädagogische Hochschulen, (PH) and 2) Universities, which included "Gesamthochschulen" (GHS) and "Technische Hochschulen" (TH).

An analysis of the questionnaire results by section and item follows:

B. The following questions concern basic information about the size and scope of your program.

6. If your state ("Land") has more than one level of certification for secondary school mathematics teachers, please fill in the blanks in the following sentence:

   The program of studies covered by this questionnaire leads to teacher certification at level _____ (from the top) of _____ levels.

At what school levels and in what programs will your graduates be legally permitted to teach? (Circle the total pupil years in school in each case).

7.	Gymnasium	5	6	7	8	9	10	11	12	13
8.	Realschule	5	6	7	8	9	10	11	12	
9.	Hauptschule	5	6	7	8	9	10	11	12	
10.	Volksschule	5	6	7	8	9	10			

Item 6 was evidently poorly understood by the German sample and was omitted by most respondents. There was insufficient response for analysis. The number of nonrespondents for items 7-10 also suggested some difficulty in comprehension, but the results are printed in table D1. These are based upon respondents' perceptions of certification regulations.

TABLE D1

Highest grade level permitted to teach according to training**

		NR*	9	10	11	12	13
P. H.	Gymnasium	5		4			
N=9	Realschule		1	6	-	-	-
	Hauptschule	1	5	6	-	-	-
Univ.	Gymnasium	9		1			9
N = 19	Realschule	12		7	-	-	-
	Hauptschule	9	3	4	-	-	-

*Here and in all other tables NR = No Response

**Numbers in the table are the number of responses

Thus only university trained teachers are permitted to teach at the upper levels of the Gymnasium, while graduates of the P.H.'s may teach up to grade 10 in all schools.

What percentage of your entering students have completed each of the following types of secondary school?

11. _____ Gymnasium 13. _____ other: _____

12. _____ Realschule 14. _____ other: _____

These items deal with the academic and school background of the program entrants. Teacher training programs in a stratified school system tend to permit their graduates to teach at no higher a level than that which they attended in secondary school. Table D2 shows approximately where students come from prior to entry into teacher training programs.

TABLE D2

Secondary School Source of Program Entrants

		NR	0-20%	60-80%	80-100%
PH N=9	Gymnasium	2			7
	Realschule	7	1		1
	Other	5	3		1
University N=19	Gymnasium	3			15
	Realschule	18		1	
	Other	11	7		

Clearly the bulk of students for both institution types come from the Gymnasium. Note also that no response may well indicate a "0" response. One university admits 60-80% of its students from Realschule.

15. What is the total (elementary and secondary) minimum number of years of schooling required for entrance into your mathematics teacher training program?

a) 10 b) 11 c) 12 d) 13 e) not specified

One university and one PH indicated admissability from grade 10 (i.e., 10 total years of schooling), all others normally wanted completion of 13 years of schooling for entrance, the basic Gymnasium program.

16. How many years of full time study at the tertiary level are normally required for certification? (Circle your response)

a) 2 b) 3 c) 4 d) 5 e) 6 or more

There are some variation on this item, indicating a wide variety of programs and local or state options. See Table D3 for this data.

TABLE D3

Number of Years Normally Required in Program

Years	3	4	5	6 or more
P.H.	6	2	1	
University	4	5	8	2

The 3 year program results in a total school tenure of 16 years - the norm in North America. While a few universities have programs this short, most require more, many up to 5 years. The latter usually expect work in mathematics to be up to, or close to, the Ph.D. level.

17. Circle the average yearly number of graduates over the past three years:

a) 0-10 b) 11-25 c) 26-50 d) 51-75 e) greater than 75

An indication of the size of the program is given by the response to item 17 as shown in Table D4.

TABLE D4

Number of Institutions Having Indicated Average Number of Graduates

	NR	0-10	11-25	26-50	51-75	75
P.H. (N=9)			2	4		3
University (N=19)	1	1	7	5	4	1

This shows a wide range of sizes among the responding programs. A student body of less than 10 per year would likely have problems of viability, but only 1 institution, a university, fell below this level.

18. What percent of your entering students fail to complete the teacher training program successfully?

a) less than 10 b) 10-20 c) 21-30 d) 30-40 3) greater than 40

Both selection procedures and the program of study itself affect the attrition rate of students. Within the program academic rigor, counselling and the students' suitability for teaching all play a role. Table D5 indicates how many fail to complete successfully. The reasons for such failure are numerous and often local. A high rate may be seen positively as weeding out individuals unsuited for the classroom or negatively as indicating too rigorous a program or poor selection procedures.

TABLE D5

Attrition Rate of Students - Percentages

	N.R.	5-10%	10-20%	21-30%	30-40%	40%
P.H. (N=9)		4	2	1	1	1
University (N=19)	1	5	8	3	2	

19. Give an estimate of the percentage of your graduates who are now teaching:

a) less than 40 b) 40-60 c) 61-80 d) 81-100 e) do not know

Item 19 was asked in view of the teacher over supply in many areas due to decreasing school enrollments. Many teacher-trainers do not know precisely who is employed and who is not, but do have a general picture of the employment situation in their geographic area as well as an idea of the demand for their graduates. Table D6 presents these perceptions.

TABLE D6

Percentages of Graduates Presently Employed

	NR	< 40	40-60	61-80	81-100	do not know
P.H. (N=9)				2	6	1
University (N=19)			2	1	13	3

While these figures suggest that employment may be quite difficult in a few areas in 1980, the overall picture is a healthy one for the graduates.

Section C summarizes content requirements in Mathematics in terms of Class/lecture hours expended (endured?) during the duration of the program. The questionnaire items were:

C. *The following items ask for the minimum number of semester hours required in various areas of mathematics over the total duration of the training program. (1 semester hour = 1 hour per week for 12-15 weeks). For each item place the appropriate letter from the list of hours below:*

a) 0 b) 1 c) 2-3 d) 4-6 e) more than 6

20. ____ analysis/calculus
21. ____ geometry
22. ____ linear algebra
23. ____ modern algebra
24. ____ topology
25. ____ numerical methods
26. ____ probability and statistics
27. ____ number theory
28. ____ logic/set theory
29. ____ mathematical applications
30. ____ computers/information
31. ____ other: _____

Table D7 shows the data for all of these mathematical topics. A few respondents indicated that portions of their program were elective. Discussion follows topic by topic.

Analysis/Calculus. Only one respondent (P.H.) indicated that this is not part of the requirements. In fact, it receives rather heavy emphasis, with 20 out of 28 institutions requiring 4 or more semester hours. Likely only the university graduates will teach the subject in in their future positions at high grade levels. As elsewhere on this section, one hopes that the nonrespondents are not omitting important topics.

Geometry. Again a topic receiving emphasis, though somewhat less than analysis. Again also on an important topic such as this, the hope is that nonresponders are not omitters. Two universities do apparently neglect geometry. Nothing in the questionnaire indicates what sort of geometry might be included under this heading and presumably a wide range of topics and geometries are dealt with.

TABLE D7

Mathematics Content - Semester Hours Required

	N.R.	0	1	2-3	4-6	>6
Analysis/Calculus						
P.H.	1	1		1	5	1
University	2			3	9	5
Geometry						
P.H.				2	6	1
University	3	2		4	9	1
Linear Algebra						
P.H.	1	1	2		5	
University	2	2		2	9	4
Modern Algebra						
P.H.	1	1		1	6	
University	4		1	6	7	1
Topology						
P.H.	2	4	2		1	
University	4	7	2		6	
Numerical Methods						
P.H.	2	2	1	1	3	
University	4	6	1	4	4	
Probability and Statistics						
P.H.	1	1		4	3	
University	3	2	1	6	6	1
Number Theory						
P.H.		3		3	3	
University	4	5	3	5	2	
Logic and Set Theory						
P.H.		2		6	1	
University	3	2	3	4	7	
Math Applications						
P.H.		4	1	3	1	
University	4	5		5	5	
Informatics						
P. H.		2	2	4	1	
University	4	4	2	8	1	

Linear Algebra: This appears to be considered somewhat less important than the two preceding topics, with one group of institutions at the low end (8), but more than half (18) at the upper end of the requirement range. It appears to attract more attention at the university than at the PH.

Modern Algebra. This topic is considered important in both types of institutions with 75% of them requiring at least a basic course in the area.

Topology. With the exception of one PH and a group of six universities, topology receives minimal emphasis. More than 50% give it one semester hour or less time.

Numerical Methods. Clearly there are differing views on the importance of this topic. A significant number consider it worth considerable time, while just as many view it as not worthy of coursetime.

Probability and Statistics. About two-thirds of respondents indicated an important place in their program requirements for this area of study. Only a very small number considered it worth little or no time.

Number Theory. This topic was considered important enought for at least 2-3 semester hours by about half of the respondents. No particular correlation with institutional type is readily apparent.

Logic and Set Theory. While this is omitted as a course by a small number of institutions, the majority clearly consider it important enough for 4-6 hours or more.

Math Applications. About half of the institutions do not require explicit courses dealing with applications, while the other have given it at least 4 semester hours. Many require more than this.

Informatics. Half of the respondents indicate one semester hour or less in this area, while the largest group falls in the 4-6 hour category. (It is hard for this observer to comprehend how anything less than this could be adequate for any computer implementation in schools.)

D. The items in this group deal with your evaluation of the adequacy of the content background offered by this program.

32. The students in this program have _____ background in mathematics for the courses they will be expected to teach. (Fill in the blank from the given list.)

a) not enough b) adequate c) much more than adequate

If you chose (a), not enough mathematics, indicate below the area(s) in which you feel the weaknesses lie.

This item explores the judgment of mathematical adequacy for the teaching job the students will be doing. These responses are personal to the respondent, rather than descriptive of the program, but relate directly to the preceding section. A few respondents indicated areas of weakness. Algebra, geometry and "foundations (philosophy)" were most commonly mentioned.

TABLE D8

	NR	Not adequate	Adequate	More than adequate
P.H.	0	4	5	0
University	2	4	13	0

E. This group of items concerns the teaching subjects for which the student is training.

33. Is a second teaching subject (in addition to mathematics) required for teaching certification? (Circle your answer)

YES NO

If your answer to question 33 is YES, please answer questions 34-47. If not, go to section *F*.

For items 34-47 please answer by indicating with an *x* if the listed subjects are available as a second subject with mathematics.

34. ____ astronomy
35. ____ biology
36. ____ chemistry
37. ____ informatics
38. ____ physics
39. ____ other: _____
40. ____ ancient language(s)
41. ____ modern foreign language(s)
42. ____ native language
43. ____ geography
44. ____ economics
45. ____ sociology
46. ____ history

With the exception of a single nonresponder, all of the West German institutions indicated that a second teachable subject was required for teacher certification. Table D9 lists the second subjects available with mathematics. The questionnaire items made no distinction between major subject (Hauptfach) and minor subject (Nebenfach).

TABLE D9

Available Second Subjects - Number saying "YES"

Subject	PH N=9	University N=19
Astronomy	0	0
Biology	9	13
Chemistry	9	13
Informatics	1	1
Physics	9	16
Ancient Language	2	2
Modern foreign language	9	12
Native language	7	12
Geography	9	11
Economics	2	7
Sociology	1	7
History	9	11
Other	8	12

Important "others" included: art, music, physical education (sport), religion, and technical subjects, e.g., "Elektrotechnik" and "Machinenbau." Not unexpectedly physics is the most available second subject. However, a wide range of choices is available at virtually all institutions.

F. *This set of questions relates to the general professional (non-subject-matter related) educational components of the student's program.*

Are required courses or significant parts of courses devoted to the following areas?

a) YES b) NO c) do not know

48. ____ history of education
49. ____ sociology of education
50. ____ general curriculum

This entire section is concerned with general professional areas whether or not they constitute separate courses. There were no "do not know" responses. The data is shown in Table D10.

TABLE D10

Required Professional Education - Number Saying "YES"

	PH N=9	University N=19
History of Education	7	10
Sociology of Education	7	12
Administration	6	7
General Curriculum	4	4

While all respondents indicated work required in these areas, one indicated the elective nature of the program by stating "The educational training in _____ is a catastrophe: no structure, no obligations, no requirements...." At the same institution, the most commonly elected second subject was sport.

TABLE D11

General Professional Education - Semester Hours Required

	NR	0	1	2-3	4-6	>6
Developmental Psychology						
PH	1	0	3	3	2	
University	2	1	2	12	1	
Adolescent Psychology						
PH	1		2	5	1	
University	3	1	8	6		
Motivation						
PH	1		2	5	1	
University	4	1	6	7		
Learning Theory						
PH	1		2	3	3	
University	2		6	9	1	
Microteaching						
PH	4	1	3	1		
University	12	2	1	3		
General Instruction Methods						
PH	4		2	1	1	1
University	4		4	5	4	1
Diagnosis and Remediation						
PH	5		3	1		
University	11	3	1	2	1	
Audio-Visual Media						
PH	4		3	2		
University	8		4	5		
School Orientation Visits						
PH	4		1	1	1	2
University	4		1	4	9	
Individualization						
PH	4		3	1	1	
University	6		4	7	1	
Computer Assisted Instruction						
PH	4	2	3			
University	12	7				

Table D11 summarizes the data from items 52-62 regarding educational psychology requirements and general instructional and school orientational activities. The large number of nonresponses for many of these categories suggests that a large proportion of the NR's should in fact be "0s", i.e., they devote little or not time to the topics. Note that most institutions do require some work in educational psychology, including learning theory, whereas the response for the general methodological courses was more varied and a majority required some school visitation.

Each of the following items asks for the number of semester hours devoted to a particular area or topic. These items may be answered according to the following scheme.

a) 0 b) 1 c) 2-3 d) 4-6 e) more than 6

52. ____ developmental psychology
53. ____ adolescent psychology
54. ____ motivation
55. ____ learning theories

What is the number of semester hours devoted to each of the following activities in a non-subject-matter setting?

56. ____ microteaching (by whatever approach)
57. ____ general instructional methods
58. ____ diagnostic and remedial teaching
59. ____ audio-visual media familiarization
60. ____ school orientation visits
61. ____ differentiation/individualization
62. ____ computer assisted instruction

G. *The items in this set deal with the school practicum experience, i.e., lessons taught in the school setting.*

63. In what year of a student's program is the first school practicum experience? (Circle your answer)

a) 1st b) 2nd c) 3rd d) 4th e) later than 4th

64. Is the school practicum supervision from your institution carried out by someone familiar with mathematics teaching?

YES NO

65. Does the school practicum time fall within or outside of the time of the regular academic semester?

a) within b) outside c) other _____

Section G concerns the practicum in the schools, i.e., student teaching. The time of occurance of the first such experience for the student and the qualifications of the supervisor are the subject of items 63 and 64. In the programs of some institutions, the practicum falls within the regular institutional semester and in others outside of it. In still others, a mix of these is possible. The responses to these three items are given in Tables D12, D13, and D14.

TABLE D12

Year of Occurance of First Practicum

	1	2	3	4	later than 4
PH (N=9)	7	1	1		
University (N=19)	4	10	4		

TABLE D13

Familiarity of Supervisor with Mathematics

	NR	YES	NO
PH (N=9)	1	6	2
University (N=19)	1	15	3

TABLE D14

Relation of Practicum to Semester Timetable

	NR	within	outside	other
PH (N=8)		1	1	7
University (N=19)	1	1	6	11

While the explicit details of the arrangements for practice in the "other" category are not evident, it does seem that many overlap both regular semesters and other time blocks.

In order to determine the approximate number of inschool days during the practice, items 66-72 were included. The data as given were converted to days/years and are shown in the latter form in Table D15. In the case of the PH's, we know from Table D3 that most students have completed their programs of study within three years, and all within 5 years. The length of study program is more variable within the universities and most of the practice appears to be completed by year 3 or 4.

Please complete the table below indicating the number of weeks and days per week of the school practicum for each year of a student's program.

	days/week	for	weeks/year
66. year 1	_____		_____
67. year 2	_____		_____
68. year 3	_____		_____
69. year 4	_____		_____
70. year 5	_____		_____
71. year 6	_____		_____
72. beyond year 6	_____		_____

The remainder of the questionnaire deals with the mathematics teaching methods component of the teacher training program.

TABLE D15

Days of Practicum in each year by School Type

School	year	days: 0-5	6-20	21-50	51-75
PH	1	2	2	5	
	2	2		5	2
	3	2	5	2	
	4	1	2		
	5			2	
University	1	16	2	1	
	2	10	1	8	
	3	5	8	6	
	4	all*	5		
	5	all	3		
	6 or more	all			

*"all" indicates all programs that still retain students.

73. During what year of a student's program does the first course in mathematics teaching methods appear? (Circle your answer)

a) 1 b) 2 c) 3 d) 4 e) 5 or higher

74. On the reverse side of this sheet list the main textbooks (published or self-constructed) used in your mathematics education courses. Rate the use of each book according to the following scale by placing the appropriate letter next to the listing.

a) used as basis for a course/carefully followed

b) used as basis for a course/partially followed

c) used for occasional reading and written assignments

d) seldom referred to but recommended or required for students

The last two items in section G concern time of occurrence of the first teaching methods course and the textbooks used for such courses. These data are presented in Tables D16 and D17 respectively.

TABLE D16

Year of appearance of First Mathematics Teaching Methods Course - by School

	NR	Year: 1	2	3	4	5 or later
PH (N=9)		5	4			
University (N=19)	2	4	11	1		1

Here as with the practica, the student is introduced early in his program to the actual teaching of mathematics. One university is an exception to this rule, waiting until the end of a long program to introduce students to mathematical teaching methodology.

A list of textbooks given by respondents is given in Table D17. Not all respondents listed texts and the table does not include self-constructed materials used by the author/respondent alone. Naturally many instructors develop material for use in their classes and it was not the objective here to list such materials, nor textbooks dealing with mathematics subject matter. A number of respondents indicated that no particular textbooks were used.

TABLE D17

Textbook Use - West Germany

Bigalke & Hasemann: Zur Didaktik der Mathematik in den Klassen 5-6.

Freudenthal, H. Mathematics as an Educational Task.

Fricke, Besuden, Mathematik - Elemente einer Didaktik.

Griesel, Die neue Mathematik für Lehrer and Studenten.

Holland, G. Geometrie für Lehrer und Studenten.

Lindemann & Schindler, Neuorientierung des Mathematikunterrichts.

Meschkowski, Didaktik der Mathematik.

Müller, . & Wittmann, E. Der Mathematikunterricht in der Primarstufe.

Vollrath, H-J. Didaktik der Algebra.

Wittmann, E. Grundfragen des Mathematikunterrichts.

Zech, F. Grundkurs Mathematikdidaktik.

Section H deals with the activities and assignments which are part of mathematics education courses and seminars. Table D18 summarizes the activities included in each respondent's program.

H. Below are listed activities or projects often required of students in mathematics education courses. Please check those which are included in your program.

75. ____ membership in professional organizations
76. ____ attendance at a mathematics teachers' conference
77. ____ analysis of video-taped lessons
78. ____ designing/developing learning packets
79. ____ comparing textbooks and their approaches
80. ____ developing drill and practice exercises
81. ____ developing exercises in problem solving
82. ____ reading articles on curricular issues
83. ____ reading articles or books on theories of learning mathematics
84. ____ other: _____

TABLE D18

Activities Included in Mathematics Education Courses - by School Type

Activity	PH N=9	University N=19
Membership in Professional Organizations	0	0
Attendance at Math. Teachers' Conference	0	2
Analysis of video taped lessons	4	9
Develop. learning packets	5	13
Comparing textbook approaches	6	15
Develop drill and practice exercises	6	4
Develop exercises in problem solving	7	5
Reading articles on curriculum	6	14
Reading articles on theories of learning math	7	12

I. *Below are listed topics or areas dealt with directly in the school mathematics classroom. How much attention do you give to the "How to teach" for each of these topics?*

a) none b) little c) moderate d) great

85. ____ problem solving
86. ____ concepts
87. ____ methods of proof/logical structure
88. ____ algorithms
89. ____ facts
90. ____ use of the calculator
91. ____ use of the computer
92. ____ applications of mathematics
93. ____ specific mathematical topics
94. ____ other: _____

The data in Table D19 for Section I give an indication of the relative emphasis given to how to teach various components of mathematics.

The area of computer use appears to be the least emphasized among all the listed topics. In fact, it is the only one which does not receive moderate or greater emphasis from at least half of the programs respondents.

TABLE D19

Emphases given to "How to Teach" selected Mathematical topics

Topic and School	NR	none	little	moderate	great
Problem Solving					
PH	0	0	6	2	7
University	1	0	2	3	9
Concepts					
PH		1	1	5	2
University	2	0	2	8	7
Proof/Logic					
PM	1	0	1	4	3
University	1	1	3	6	8
Algorithms					
PM	1	0	0	3	6
University	2	2	3	10	2
Facts					
PM	0	0	3	5	1
University	3	5	4	6	1
Calculator use					
PH	0	0	2	7	0
University	3	2	6	8	0
Computer use					
PH	0	3	2	3	1
University	5	3	10	1	0
Applications of Math					
PH	0	0	0	6	3
University	3	0	1	9	6
Spec. Math. Topics					
PH	2	1	2	3	0
University	6	0	2	5	6

The preceding section dealt with how to teach particular elements or facets of mathematics. The following section is more concerned with the kinds of things a teacher must do in and outside the classroom in order to carry out his teaching task. These are items often discussed in teaching methods courses. Table D20 displays the data; immediately following is the actual questionnaire item.

TABLE D20

Curriculum and Instruction Topics Discussed
in Teaching Methods Course-Emphasis by School Type

	NR	none	little	moderate	great
Sequencing Content					
PH	1	0	1	2	5
University	3	0	0	2	14
Formulating Goals					
PH	1	0	2	5	1
University	2	0	3	7	7
Questioning Techniques					
PH	2	1	2	4	0
University	4	0	1	10	4
Teaching Strategies					
PH	2	0	1	4	2
University	3	0	6	8	2
Selecting Pupil Activities					
PH	2	0	1	2	4
University	4	0	3	10	2
Test Construction and Evaluation					
PH	2	1	4	2	0
University	4	4	4	7	0
Diagnosis and Remediation					
PH	3	0	5	1	0
University	4	6	8	1	0
Computer Assisted Instruction					
PH	3	3	3	0	0
University	4	11	2	2	0
Comparing Textbooks					
PH	2	0	1	2	4
University	2	1	3	11	2
Develop. Learning Packets					
PH	2	0	0	5	2
University	3	1	4	2	9
Using Concrete Materials					
PH	1	0	1	5	2
University	4	1	3	8	3
Individualization					
PH	2	1	1	3	2
University	5	0	2	12	0

J. The following topics are often discussed in a teaching methods course as areas of concern in helping a teacher with his classroom curriculum and instruction. How much attention do you pay to each of these? (Answer as in part I above).

95. ____ sequencing mathematical content
96. ____ formulating goals
97. ____ questioning techniques
98. ____ selecting and carrying out teaching strategies
99. ____ selecting pupil activities
100. ____ test construction and evaluation
101. ____ diagnosis and remediation
102. ____ computer assisted instruction
103. ____ comparing textbooks
104. ____ how to develop learning packets
105. ____ using concrete materials
106. ____ individualization/differentiation
107. ____ other: _____

Areas in Section J which attract moderate or heavy emphasis included all those listed except "diagnosis and remediation", "computer assisted instruction" and "test construction and evaluation".

Section K concerns the relative emphasis placed on teaching topics in the various branches of mathematics.

K. How much attention is paid specifically to how to teach topics in each of the following areas of mathematics? (Answer as in part I)

108. ____ geometry
109. ____ algebra
110. ____ probability
111. ____ statistics
112. ____ trigonometry
113. ____ analysis/calculus

The data for this section appear in Table D21.

TABLE D21

Relative Emphasis on How to Teach Topics in Various Branches of Mathematics

	NR	None	Little	Moderate	Great
Geometry					
PH	0	0	0	4	5
University	2	0	3	3	11
Algebra					
PH	0	0	0	4	5
University	2	0	1	5	11
Probability					
PH	0	0	4	5	0
University	3	1	5	4	6
Statistics					
PH	0	0	6	3	0
University	4	0	7	5	3
Trigonometry					
PH	0	5	4	0	0
University	4	7	4	4	0
Analysis/Calculus					
PH	0	4	3	0	0
University	3	5	2	2	7

It is evident from the data in the above table that the heaviest emphasis is on how to teach topics in algebra and geometry. This seems reasonable in view of the fact that the bulk of the secondary mathematics curriculum deals with these areas. Some attention is given to probability and statistics with slightly more emphasis on the former. Appropriately calculus receives more attention at the university, but is nevertheless omitted and given little emphasis by about half of the programs.

Trigonometry is given little emphasis, although this may be due to a language difficulty. Simple triangle trigonometry is integrated into the mathematics curriculum from about year 8 or 9 onwards. The more general trigonometric notions and the functional viewpoint are developed in subsequent years. The separate high school course, North American style, does not exist. Thus the heading Trigonometry may have attracted fewer respondents than intended.

Sections L and M provide an attempt to determine what writers/theoreticians are being read and used in order to provide background and a theoretical basis for the teaching of mathematics. The first of these sections asks in a general way what writings are used, while the second section asks the respondent to associate names of theoreticians to instructional areas. Section L appeared in the questionnaire as follows:

L. *In attempting to give a theoretical basis to the teaching of mathematics, to what extent do you draw upon the writings of the following. Please select your response from the list immediately below:*

a) do not know the writings

b) know the name, but do not use

c) use the ideas implicitly

d) ideas and name explicitly discussed

114. ____ E. Castelnuovo
115. ____ Z. Dienes
116. ____ A. Engel
117. ____ H. Freudenthal
118. ____ C. Gattengno
119. ____ K. Henderson
120. ____ H. Meschkowski
121. ____ G. & F. Papy
122. ____ G. Polya
123. ____ R. Skemp
124. ____ J. van Dormolen
125. ____ P. van Hiele
126. ____ D. Ausubel
127. ____ B. Bloom (taxonomy)
128. ____ J. Bruner
129. ____ R. Gagné
130. ____ P. Gal'perin
131. ____ L. Landa
132. ____ J. Piaget
133. ____ other: _____
134. ____ other: _____
135. ____ other: _____
136. ____ other: _____
137. ____ other: _____

Items 133 and following give the respondent the opportunity to name others not on the list. While many took advantage of the opportunity, only a few additional writers were named by more than two respondents. These few are included in Table D22.

TABLE D22

Authors used to provide a basis for teaching mathematics

Writer	School type	NR	Writings Unknown	Known Not used	Used Implicitly	Used Explicitly
Castelnuovo	PH	0	0	4	5	0
	University	1	0	16	1	1
Dienes	PH	0	0	2	0	7
	University	1	0	3	5	10
Engel	PH	0	0	2	3	4
	University	2	0	4	3	10
Freudenthal	PH	0	0	0	4	5
	University	1	0	0	9	9
Gattengo	PH	0	0	5	4	0
	University	2	0	14	3	0
Henderson	PH	0	0	5	4	0
	University	1	12	3	1	2
Meschkowski	PH	0	0	2	6	1
	University	2	0	10	4	3
Papy	PH	0	0	1	6	2
	University	1	0	3	9	6
Polya	PH	0	0	0	4	5
	University	1	0	1	4	13
Skemp	PH	0	3	2	4	0
	University	2	10	0	5	2
van Dormolen	PH	0	3	3	1	2
	University	2	1	4	6	6
van Hiele	PH	0	1	4	3	1
	University	2	0	5	8	4
Ausubel	PH	0	0	2	6	1
	University	1	0	2	13	3
Bloom	PH	0	0	4	5	0
	University	0	0	2	7	10
Bruner	PH	0	0	1	1	7
	University	0	0	2	0	17
Gagné	PH	1	0	1	4	3
	University	1	0	1	6	11
Galperin	PH	0	2	4	2	1
	University	2	2	5	6	4
Landa	PH	0	6	3	0	0
	University	2	7	7	0	3
Piaget	PH	0	0	0	4	3
	University	1	0	1	0	17
Fricke	PH				1	2
	University				0	2
Heckhausen	PH				1	1
	University				0	2
Wittmann	PH				1	4
	University				0	3
Zech	PH				1	0
	University				0	1

The NR column has been omitted for the "write-ins." It is clear from the data that Skemp and Landa are not well known writers in Germany and that Henderson is known by PH respondents, but less well by university people. Those writers used explicitly or implicitly, by a majority of the respondents' programs include: Dienes, Engel, Freudenthal, Meschkowski, the Papys, Polya, van Dormolen, van Hiele, Ausubel, Bloom, Bruner, Gagné and Piaget.

The following items attempt to provide more explicit information on the topic areas where these writers are considered important. There was a high level of nonresponse for a number of these items, more than 50% in some cases. Multiple responses were permitted and thus the totals for each column are variable. The data for this section is presented in Table D23.

M. For each of the areas listed below (taken from parts I and J above) indicate the number(s) corresponding to the writer(s) from L upon whom you base your instructional activities. (If none, enter 0)

138. ____ teaching problem solving
139. ____ teaching concepts
140. ____ teaching proof and logical structure
141. ____ teaching algorithms
142. ____ teaching facts
143. ____ sequencing mathematical content
144. ____ formulating goals
145. ____ questioning techniques
146. ____ explication of teaching strategies
147. ____ selecting an appropriate teaching strategy
148. ____ test construction and evaluation
149. ____ diagnosis and remediation
150. ____ selecting pupil activities
151. ____ other: _____
152. ____ other: _____

TABLE D23

Writers/Theoreticians used for Teaching Specified Topics

	Topics												
	138	139	140	141	142	143	144	145	146	147	148	149	150
No response	7	11	10	17	18	13	13	16	16	18	23	26	21
Castelnuovo	1	0	0	0	0	1	0	2	0	0	0	0	0
Dienes	0	6	0	0	1	2	0	0	0	1	0	1	1
A. Engel	2	0	0	8	0	0	0	0	0	1	0	0	0
Freudenthal	3	3	9	0	1	1	6	1	1	0	0	0	1
Gattengo	0	0	0	0	0	0	0	0	0	0	0	0	0
Henderson	0	1	0	0	0	0	0	0	0	1	0	0	0
Meschkowski	0	1	0	0	3	3	0	0	0	0	0	0	0
G & F Papy	0	1	0	0	3	0	0	0	1	0	0	0	0
Polya	20	0	4	0	0	0	0	2	2	0	0	0	0
Skemp	1	2	1	0	1	0	0	0	0	0	0	0	0
van Dormolen	0	2	1	1	0	3	0	2	2	1	0	0	1
van Hiele	0	1	0	0	0	2	0	0	0	0	0	0	0
Ausubel	0	1	0	0	0	0	2	0	0	0	0	0	0
Bloom	0	0	0	0	1	4	10	0	0	0	5	0	0
Bruner	0	11	3	0	0	5	1	1	2	4	0	1	3
Gagné	1	3	0	2	1	1	2	0	2	0	0	0	0
Galperin	0	1	3	0	0	0	0	0	0	0	0	0	0
Landa	0	0	0	1	0	0	0	0	0	0	0	0	0
Piaget	0	10	2	0	2	0	0	0	1	0	0	1	2

The low response rate for the later items should not come as a surprise to most mathematics educators. These items are given less emphasis, with the exception of those on teaching strategies -- an area where many instructors rely on their own experience and if it has a theoretical basis at all, it is eclectic. Assuming that 25% response is significant indication of the extent to which an author is used, then the following uses are significant:

Freudenthal on teaching proof and logical structure

Polya on problem solving

Bloom on formulating goals

Bruner on teaching concepts

Piaget on teaching concepts

One must assume here that "use" probably for most respondents meant a conscious, explicit reference to the writing of the author/theoretician.

Sections N and P of the questionnaire were open ended items, some of which requested respondents' opinions and judgments. Before treating these sections, Section O will be considered. It consisted of the following checklist of credentials required by the teacher training institution for instructors in mathematics education.

O. *In the following set of items check those credentials or requirements which are required by your department of institution for instructors in mathematics education.*

155. ____ Doctorate in mathematics

156. ____ Doctorate in mathematics education

157. ____ Either one of the above doctorates

158. ____ Completed university study of mathematics, but no thesis

159. ____ No explicit training in mathematics

160. ____ Other mathematical training: _____

161. ____ Classroom teaching experience: _____

162. ____ Explicit university level training in Pedagogy, didactics, or education

163. ____ None of the above

164. ____ Other: _____

In a hiring situation it is clear that any institution has "requirements," but it is also normally understood that these are not hard and fast rules and that a candidate's background and experience, taken as a whole, are what count. The data in Table D24 are to be viewed in this light.

TABLE D24

Credentials Required of Mathematics Education Staff

Requirement	PH	University
doctorate in mathematics	0	1
doctorate in mathematics education	0	1
either of above doctorates	8	13
complete university study of mathematics	3	10
no explicit training in mathematics	1	10
other mathematical training	0	3
classroom teaching experience	4	9
university training in pedagogy	1	3

The primary requirement appears to be the doctorate in mathematics or mathematics education, with no indicated preference. Of course, few institutions actually offer doctorates in mathematics education and few candidates are available. The German universities are somewhat more concerned that their instructors have completed university mathematics, whether or not they actually acquire the degree. Classroom teaching experience is the only other significant requirement by these institutions, but surprisingly to this observer, less than half indicate this as required.

Replies in Sections N and P were permitted in either English or German. Of the 19 individuals who responded, 9 did so in English, 10 in German. Items 153-154 (four items due to a numbering error) ask for judgments about the respondent's own program.

N. The following items are evaluative in nature. Please feel free to give expanded responses where appropriate. You may respond in legible English, Dutch, or German.

153. What do you see as the major weaknesses or areas of concern within your program? Rank order these items.

The responses to item 153 concerning weaknesses or concerns within the program generated almost as many different responses as responders. Several respondents mentioned the entrance competencies (an eternal complaint!), with special reference to geometry -- a suggestion that perhaps geometry is being slighted in today's Gymnasium program. The most commonly mentioned concern was didactics. This was expressed in a number of different ways, but the tenor of the remarks was that insufficient time and emphasis is given to this vital area. Several suggested that the relation between mathematics and pedagogy must be dealt with in more depth. One respondent said that the students need more mathematics before they can do this, while another argued that too much abstract, difficult mathematics is required and that it is not oriented toward school teaching.

The concern of required versus elective programs of study surfaced from several sources. A few responders indicated (as a weakness) that much of their program was elective, without very many requirements. Others said that the program was too rigid in the area of mathematics. Finally, the Practicum was mentioned by several. The major concern here was that it was often too little, too late. On the other hand, some thought it sufficient and that the Referendariat obviated the need for further practicum.

In summary, the responses to this item fell into four broad areas of concern:

1) entrance competencies - students weak in mathematics, especially geometry
2) didactics emphasis - too little
3) mathematics - quantity and kind
4) practicum - duration and position in program of study

152. What do you see as the most important didactical aspects of your program for training mathematics teachers?

Again a wide variety of responses appeared. The most popular one related to didactics, as one respondent put it, "a didactically oriented analysis" of the mathematics content. The selection of teaching strategies and sequencing of content follow directly from this. Also mentioned was the effort to relate didactics and pedagogy to what goes on every day in the school classroom. Teaching mathematics as a process was emphasized by others, while the emphasis on a well structured practicum was also highlighted. Thus the responses might be grouped into three broad groups:

1) didactics of mathematics
2) Mathematics - content and process
3) practicum

153. Do you see any strong tendencies to change in your program in the near future (3 to 5 years)? If YES, briefly describe them.

About one-third of the respondents indicated that some changes were being planned either by the institution itself or, in a few cases, at the instigation of the Land government. The nature of these anticipated changes was not usually indicated, but two ideas appeared in several answers: 1) institution of examinations in mathematics courses at the end of each semester rather than at the end of a longer period of study, and 2) stronger differentiation among training courses related to different levels and school program types (Gymnasium, Haupt/Realschule).

154. Have you ever surveyed the graduates of your program or their employers to determine what they see as the major strengths and weaknesses?

a) YES b) NO c) Survey now in progress

If YES, what aspects of the program were mentioned most? By whom?

Strengths	Weaknesses

Undoubtedly most professionals involved with the training of mathematics teachers are continuously and informally evaluating their students and programs with respect to what goes on in the schools. Nevertheless, a more formal approach to such assessment may at times be useful. Only two indicated that any formal sort of a survey had been carried out, and another two indicated such surveys in progress. The results of the former two suggested that students possessed a good background in mathematics, but no real idea of the classroom situation.

Section P is concerned with continuing, or inservice, education.

P. *The questionnaire up to this point has concerned itself with the educational program required to gain the necessary initial certificate or teaching credentials in order to teach mathematics in a secondary school. Beyond this, further education and professional development may be available to the practicing teacher.*

165. What further education, if any, in either mathematics or education, is required by state authorities to maintain appropriate professional status?

The "Referendariat" was referred to by many respondents, although some clearly saw this as part of the initial certification process rather than professional maintenance. This period of supervised teaching normally lasts from 1½ to 2 years and is accompanied by teaching method courses. At the conclusion of this stage state examinations are written. Beyond these "Referendar years" most Länder make no requirements on further education.

Although requirements of further inservice education are rare, a large number of opportunities are available as indicated by the responses to item 166 and 167.

166. What further formal or informal courses or workshops, presented by educational institutions, ministry of education officials, or professional organizations are available to the professionally interested teacher? Briefly describe such activities and their sponsorship.

167. When new curriculum is introduced into the schools, what updating opportunities are available to teachers?

It appears that a wide variety of courses and workshops are offered in virtually all Länder by the universities and the ministries of education. In a few cases a Landesinstitut has been established by the government to coordinate continuing education activities, (e.g., Bayern, Niedersachsen, Hessen). The responses to item 167 suggest that these traditional means and institutions are employed to introduce teachers to new curricula. One respondent also mentioned textbook publishers as a source of information, particularly when new texts have been introduced.

A final question of some substance asked for the responders' view of major issues facing mathematics teacher education today:

168. If possible, identify one or two of what you regard as the major questions or problems facing mathematics teacher education today.

This is a heavy question and responses ranged from the trivial to the nonintelligible to real issues. The most frequently mentioned concern was the professionalization of the teacher. This is not restricted to mathematics, but perhaps the solution for us is in part through mathematics. Other specifics mentioned in this vein were: endowing the teacher with a professional identity and getting the university oriented to viewing teacher education as a modern profession, changing, and in need of appropriate materials and programs.

Another substantive issue mentioned in several answers was the need for more research based theories in mathematics education and a better balance and integration of mathematics and mathematics education. Other responses, important as they are, tended to be more local and institutional and were already elucidated under the items in section N.

169. Would you be willing to discuss your program further with this investigator in a personal conversation?

170. Would you be interested in receiving a summary of the report of this survey?

The last two items were answered as shown in Table 25D.

TABLE 25D

Interest in the Survey

	YES	NO
169. Willingness to discuss	17	3
170. Desire to receive survey results	18	0

A SURVEY OF SECONDARY MATHEMATICS TEACHER TRAINING PRACTICES IN WEST GERMANY AND THE NETHERLANDS

Summary of West German Results

Questionnaires were sent to a total of 21 university and 16 Paedagogische Hochschule (PH) instructors. Completed returns were received from 11 university and 8 PH instructors for a return rate of approximately 50%. The twenty-eight programs represented varied in size from one university program with less than ten graduates per year to three PHs with 75 or more. Both types of institutions received most of their students from the gymnasium.

Analysis/Calculus was considered an important area of study by all programs, with most other areas of mathematics being given moderate or little attention. For many geometry was an area of some emphasis and also an area in which the entering skills were considered weak. Linear Algebra and Modern Algebra were the next most stressed topics followed by Probability and Statistics and Logic and Set Theory. About half of the programs gave some attention to informatics and computers, while the remainder gave little or no work in this area. The mathematics background of students completing the teacher training programs was considered adequate by about 70% of those responding, while just over 25% felt that inadequate mathematics was provided. A second teaching subject in addition to mathematics was required by virtually all programs and a wide range of choices was available. The natural sciences were the most commonly available although native language, history, and geography were close seconds.

In the area of general courses in education, most of the PHs and about 60% of the university programs required work in history and sociology of education. Lesser proportions required courses in general curriculum and school administration. Most required work in developmental and adolescent psychology, motivation, and learning theory. The patterns of required work did not appear to differ between the two types of institutions.

For the great majority of programs school practicum work has begun by the second year of the program. Much of this work takes place outside of the regular academic semester. The number of days of school practicum is slightly greater for PH students than for this in the university. Beyond the regular teacher training in the academic institution there is a 1 to 2 year period of supervised practice and teaching methods courses called the "Referendariat" after which state examinations are written for the full teacher's certificate.

When activities included in mathematics education courses are listed, the proportions of programs indicating inclusion of the activity are not dissimilar for the two types of institutions. Four kinds of actitities were common to a large extent: Developing learning packets, Comparing textbook approaches, Reading articles on curriculum, and Reading articles on theories of learning mathematics.

In the "how to teach" category the following were rated as receiving moderate to great attention: problem solving, concepts, proof/logic, algorithms, and applications of mathematics. The sequencing of mathematical content is given emphasis by all; teaching strategies, selecting pupil activities, questioning techniques, and formulating goals were also stressed areas.

There was little difference between insititution types in the emphasis placed on how to teach topics in the various branches of mathematics. Among writers referred to as a basis for instruction, the following were considered significant in the sense of being identified by 25% or more of the responders:

Freudenthal on teaching proof and logical structure
Polya on problem solving
Bloom on formulating goals
Bruner on teaching concepts
Piaget on teaching concepts

A number of others were explicitly referred to by many responders without a particular topic being identified. This list included Engel, Dienes, and Gagnê, with Ausubel used implicitly. With a few exceptions use of the writings did not vary from university to PH except that use tended to be more explicit in the university setting for some writers/theories.

A high proportion of these programs expected their staff to have doctorates in mathematics or mathematics education, or at the very least, to have completed university study in mathematics. Only about half required classroom teaching experience.

A "didactically oriented analysis" of mathematical content was seen as an important aspect of the program by many of the responders. The commonly mentioned concerns about the teacher training programs fell into four broad categories:

1) entrance competencies - students weak in mathematics, especially geometry.
2) didactics emphasis - too little.
3) mathematics - quantity and kind.
4) school practicum - duration and position within the program of study.

III. THE DUTCH RESULTS

The educational system of the Netherlands is in some aspects highly centralized, while in other areas there is a very high degree of local autonomy. The school system is highly structured and compartmentalized with respect to program and student ability level, a major goal of schooling being vocational preparation (including academia). Cutting across the rather rigid academic structure are individual schools and school communities (or school groupings - "Schoolgemeenschapen") providing for great freedom in curriculum and instruction, internal organization, and religious orientation. Thus most schools are Protestant (Christelijk), Catholic (Katholiek), or public (openbaar), the latter run usually by the local municipality. In a few areas of the country there are also state schools (Rijksscholen). The philosophic/religious orientation of the school depends upon the group to which it belongs, and most schools have teachers sympathetic to their views. Such an orientation, however, may have little direct effect on the school or its curriculum except for religious instruction. Curricular decisions such as textbooks and learning sequence are made at the local level, limited only by the state administered written examinations at the end of each school program.

In effect, any group can operate a school as long as they fulfil certain conditions: 1) have a sufficient number of pupils, 2) satisfy state organization requirements, and 3) satisfy state educational and examination requirements. All schools are state supported on a per pupil basis.

Secondary education begins following six years of elementary (basis) school (about 12 years old). While the basic school structure goes back to the second half of the nineteenth century, a number of fundamental changes have occured in the last twenty years. One of these major changes is a provision which allows students under certain conditions, to transfer upward from one secondary school stream to another.

The school streams for which mathematics is a required subject are shown in figure NL1 (van Dormolen, 1974, p. 6). The academic and ability level decreases from left to right. These levels are defined in the footnote.* The A and B streams within the gymnasium and

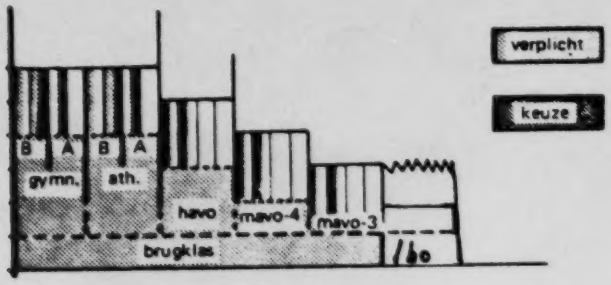

Figure NL1. Mathematics as required (verplicht) or elective (keuze) subject.*

atheneum refer to emphases in humanities/social sciences and mathematics/science respectively. This figure is based upon the school revisions promulgated in 1968 and in fact, changes have taken place since that time. In many athenea, for example, the strict A and B streams have now become less rigid and many subject combinations are possible. The "brugklas" notion of a bridge between elementary and secondary education has been extended in many schools to two and even three years. The indicated mathematics time in each of these programs is essentially correct, but is mandated beyond year 1 in terms of number of lessons in the total program rather than by years of study.

---

*

w.o.	wetenschappelijk onderwijs	academic education (university)
v.w.o.	voorbereidend w.o.	preparatory academic educ.
h.a.v.o.	hoger algemeen voortgezet onderwijs	higher, gen'l. continued educ.
m.a.v.o.	middelbaar alg. voortg. onderwijs	middle, gen'l. continued educ.
l.b.o.	lager beroepsonderwijs	lower vocational education
m.b.o.	middelbaar beroepsonderwijs	middle level voc. education
h.b.o.	hoger beroepsonderwijs	higher vocational education
brugklas	"bridge class" - first year of secondary school	
NLO	Nieuwe Lerarenopleiding	New Teacher Education

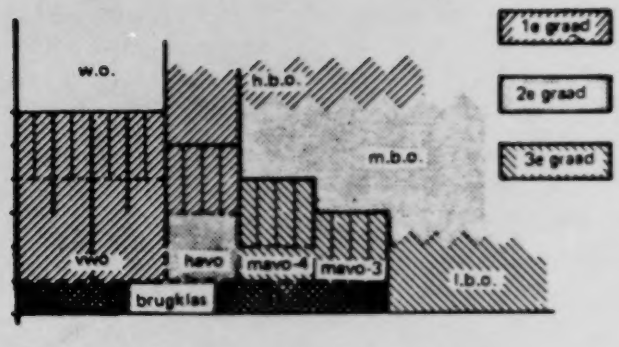

Figure NL2. Certification levels and their permissoere teaching positions.*

Figure NL2 (van Dormolen, 1974, p. 11) shows the way in which this system, with extensions to the wider realms of higher and vocational education, is reflected in the teacher certification system. This is of recent origin, although not in conflict with past practice. Prior to 1968 there was no real professional training except the normal school (Pedagogische Academie/Kweekschool) for the training of elementary school teachers. A teacher with this training could upgrade through evening school programs to the equivalent of the present level 3 certificate. The higher levels were filled by university students who obtained higher level diplomas through evening training or studied to the level of doctoral examinations. Actual professional training in education or pedagogy was minimal.

Salary and certification levels are closely tied, with certification level 1 commanding a higher salary than level 2. Thus of course to a large extent school type and age of pupils taught determine salary level. A teacher may still move up in level by attending evening school and passing appropriate examinations or, in the case of a level 2 teacher, may go to a university which will recognize his teacher's college work. With declining enrollments and school consolidations the school grade taught by persons with a particular certificate have become more flexible.

The streams/school types are shown in descending order from left to right at the bottom of the graph in Figure NL2. Students from lbo and mavo will, in large proportions, enter the world of work directly, although as Figure NL2 shows, there are further educational opportunities available to those who wish to develop special skills. Havo students may go on the middle or higher level vocational and professional training programs or, if they wish, complete atheneum (vwo) by repeating a school year at the higher level.

At the lbo level many instructors have in fact received their training at a normal school and/or have training in a particular trade. Along with the school changes instituted in 1968, changes in teacher certification placed these teachers into level 3, and made level 3 training available in the new teacher training colleges (NLOs). Level 2 training was also placed in these colleges, while level 1 training is in the university. A brief comment is appropriate here regarding the NLOs, the first of which got under way during the period 1970-73. Their major aim is to develop professionalized teachers through an integration of the pedagogical and subject matter training. Extensive investigations have been carried out to examine the organization and functioning of the NLOs and this material is summarized in the Inventariserend Onderzoek Nieuwe Lerarenopleiding: Samenvattend Rapport (1976), Voortgezet Onderzoek Nieuwe Lerarenopleiding: Een Samenvattend Verslag (1979), and Overzichtsrapport: Zes Jaar NLO-Onderzoek (1981).

For North American readers perhaps another word of explanation is necessary. In all European countries except Yugoslavia, teacher education is different for teachers for the upper level academic students (Rasing, 1975). Such teachers all receive their training at the university with study durations varying from three to six years.

Instructors from all three training groups, university, teachers' college (NLO)* and evening programs were included in the sample as shown in Table NLO. Questionnaires were sent to one individual in each of this sort of institution in the country. Returns were at a high level of return, 8 out of 8 at the NLOs and 7 out of 9 at the universities. With the exception of one special instruction to NLO instructors, all material was in English, but responses in Dutch were explicitly permitted.

In the analysis of the questionnaire data which follows, the responses from evening school instructors are not included. In some cases these were the same instructors responding for a university or NLO, in other cases they were separate individuals. In either case, the number of responders in this sort of institution was small and the programs offered are not complete teacher training programs, but usually (though not always) upgrading opportunities for those holding less than the Level 1 certificate.

NLO

Number of Dutch Responders
by Institution Type

	Responders	Programs
University	7/9	7
*NLO	8/8	14
Avondopleiding (evening)	4/5	4

*Christelijke Leergangen (Zwolle) was not included here since it is a new institution and unable at this time to complete the questionnaire.

The data from the objective response items of the returned questionnaires were analyzed using the SPSS CROSSTABS program. As well as the overall tallies for each item a crosstabulation was made by institutional type.

In the questionnaire the following definitions were presented after getting the initial biographical information:

Definition: The terms *student program* and *program of studies* will be used to refer to the total course of study at the tertiary level which leads to certification to teach mathematics in secondary schools.

The above definition was assumed throughout. Items 7-14 differed by country and appeared on page 1; all subsequent items were identical for the two countries. For the Dutch questionnaires, analysis was carried out for the two categories of institution: 1) NLO's (Nieuwe Lerarenopleiding) and 2) universities, including 2 technical universities (technische hogescholen).

B. The following questions concern basic information about the size and scope of your program.

6. If your country has more than one level of certification for secondary school mathematics teachers, please fill in the blanks in the following sentence:

The program of studies covered by this questionnaire leads to teacher certification at level _____ (from the top) of _____ levels.

At what school levels and in what programs will your graduates be legally permitted to teach? (Circle the total years in school in each case)

7.	atheneum/gymnasium	7	8	9	10	11	12	13
8.	havo	7	8	9	10	11		
9.	mavo	7	8	9	10			
10.	lbo	7	8	9	10			

The Dutch gymnasium formerly was a program which included Latin and Greek in addition to the regular program which itself included English, French, and German. This program required thirteen years of study, and was not the only choice for the university bound student. Such a program is rare now and the atheneum, 6 years on top of elementary school, has replaced the former programs and contains streams for different emphases: science, language, etc.

The data in Table NL1 clearly show that the only route to full teaching in the atheneum is through the university. By the same token, a level 1 teacher would not teach at the lower grades or in lower level schools. In fact, he could lose salary by doing so.

Table NL1

Highest Grade Level Permitted to Teach according to training*

		NR grade:	7	8	9	10	11	12/13	N/A
NLO	atheneum		14						
	havo		5			9			
	mavo					14			
	lbo					14			
university	atheneum							7	
	havo						7		
	mavo								x

*Numbers in the tables are the numbers of programs responding

There was some evidence of confusion on the above question. This could be due to lack of clarity in the question itself, or respondents' lack of familiarity with certification requirement and regulations.

What percentage of your entering students have completed each of the following types of secondary school?

11. _____ atheneum/gymnasium
12. _____ havo
13. _____ mavo
14. _____ other: _____

Items 11-14 deal with the academic and school background of program entrants. Teacher training programs in a stratified school system tend to permit their graduates to teach at no higher a level than that which they attended in secondary school. In other wards upward mobility from one stream to another is difficult, although recent reforms have made such an opportunity more readily available. The Dutch evening school system for obtaining a higher level certificate provides such an opportunity. Table NL2 shows approximately where students come from prior to entry into teacher training programs.

Table NL2

Secondary School Source of Program Entrants

Percent of entrants:		0-20	20-40	40-60	60-80	80-100	NR*
NLO	atheneum	7	6				1
	havo			2	9	3	
	mavo	12	2				
university	atheneum					7	
	havo						7
	mavo						7

*Here and in all other tables, NR = No Response

It is clear that virtually 100% of university students have completed atheneum, as to be expected. University is the goal of most atheneum students. The training for higher professional schools provided by the havo yields a good proportion of the NLO attenders, although note that NLO's accept a few students from mavo and other sources.

15. What is the total (elementary and secondary) minimum number of years of schooling required for entrance into your mathematics teacher training program?

a) 10 b) 11 c) 12 d) 13 e) not specified

The responses to item 15 parallel those to the preceding set of questions. In general, the NLO's will accept students with eleven years of training, while the universities expect 12 years.

16. How many years of full time study at the tertiary level are normally required for certification? (Circle your response)

a) 2 b) 3 c) 4 d) 5 e) 6 or more

There is little variation in the responses to this item, as shown in Table NL3.

Table NL3

Minimum Number of Years of Schooling Required

	NR	3	4	5	6 or more years
NLO (N = 14)			8	6*	
University (N=7)	2			4	1

*In some cases 4½ years

These are nominal years to completion. Many students, especially at the university need more time for the program of studies and examinations. The examinations at the university occur after long blocks of time while at the NLO's they are usually given semester by semester. An NLO graduate has spent a total of at least 15 years in school, and often 16, not dissimilar to the North American norm.

17. Circle the average yearly number of graduates over the past three years:

a) 0-10 b) 11-25 c) 26-50 d) 51-75 e) greater than 75

An indication of the size of Dutch programs is given by the data shown in Table NL4. This shows a wide range of sizes among responding programs.

Table NL4

Number of Institutions Having Indicated Average Number of Graduates in Mathematics

	NR	0-10	11-25	26-50	51-75	75
NLO (N=14)	2	4	3	3	2	
University (N=7)	1			5	1	

A math program group of 10 or less students per year would likely have problems of viability. In Holland, not every NLO is obligated to offer their program in every discipline and the offerable areas are determined by the Ministry.

18. What percent of your entering students fail to complete the teacher training program successfully?

a) less than 10 b) 10-20 c) 21-30 d) 30-40 e) greater than 40

Many factors affect the attrition rate of students, but selection procedures and the program of studies are certainly important among them. Within the program academic rigor, counselling and students' suitability for teaching all play a role. Table NL5 indicates how many fail to successfully complete the program.

Table NL5

Attrition Rate of Students - Percentages

	NR	5-10%	10-20%	20-30%	30-40%	40%
NLO (N=14)	3		3	3	5	
University (N=7)	2	5				

19. Give an estimate of the percentage of your graduates who are now teaching:

a) less than 40 b) 40-60 c) 61-80 d) 81-100 e) do not know

Item 19 was asked in view of the teacher over-supply in many areas due to decreasing school enrollments. Many teacher-trainers do not know precisely who is employed and who is not, but do have a general picture of the employment situation in their geographic area as well as an idea of the demand for their graduates. Table NL6 presents these perceptions.

Table NL6

Percentages of Graduates Presently Employed (1980)

	NR	<40%	40-60%	61-80%	81-100%	do not know
NLO (N=14)	2	2		2	6	2
University (N=7)	1	1	1	2	1	1

This suggests that while the employment picture is generally good, especially for NLO graduates, there are areas of less than full employment. It should be noted that the two single universities indicating less than 60%, both are technical schools.

Section C summarizes content requirements in Mathematics in terms of class/lecture hours expended during the duration of the program. The questionnaire items were:

C. *The following items ask for the minimum number of semester hours required in various areas of mathematics over the total duration of the training program. (1 semester hour = 1 hour per week for 12-15 weeks) For each item place the appropriate letter from the list of hours below:*

a) 0 b) 1 c) 2-3 d) 4-6 e) more than 6

20. _____ analysis/calculus
21. _____ geometry
22. _____ linear algebra
23. _____ modern algebra
24. _____ topology
25. _____ numerical methods
26. _____ probability and statistics
27. _____ number theory
28. _____ logic/set theory
29. _____ mathematical applications
30. _____ computers/informatics
31. _____ other: _____

Table NL7 shows the data for all of these mathematical topics. Discussion follows topic by topic. The NR category in this table contains a "2" for university for all topics - these are the same universities throughout this section.

Analysis/calculus. This clearly considered an important area of study for all mathematics teachers. Of the responding Dutch institutions most require more than six semester hours of study, even though many of these students will never teach the subject formally in schools.

Geometry. This topic too receives a great deal of emphasis, though somewhat less than the calculus. No responding schools omitted geometry and a majority required 4 semester hours or more. Nothing in the questionnaire indicates what sort of geometry might be included under this heading and presumably a wide range of topics and geometries are dealt with.

Linear Algebra. This topic appears to receive about the same attention as geometry, with slightly more emphasis than geometry at the university. Clearly this is considered important at both levels.

Modern Algebra. This subject receives less emphasis than the preceding ones, particularly in the NLO's, where two institutions have no requirement.

Topology. More than half of the responding programs indicated at most 1 semester hour on this topic, and all but one were at or below the 3 semester hour level.

Numerical Methods. Like topology, this topic appears to be considered only important enough for a brief course. The great majority require a maximum of 3 semester hours of work. Some material of this topic may be covered in informatic courses.

Probability and Statistics. There is clearly some difference of opinion on this area of study. Most of the NLO's require six or more hours of study, while the universities generally require less than this.

Number Theory. This is a low area of emphasis in the Dutch programs, with only two institutions requiring more than one semester hour of lecture.

Table NL7

Mathematics Content - Semester Hours Required

	NR	0	1	2-3	4-6	>6
Analysis/Calculus						
NLO					2	12
University	2					5
Geometry						
NLO			2		6	6
University	2			4	1	
Linear Algebra						
NLO					8	6
University	2				4	1
Modern Algebra						
NLO		2		4	4	4
University	2				4	1
Topology						
NLO		6	5	3		
University	2		2	2		1
Numerical Methods						
NLO		4	4	5		1
University	2	1	1	2	1	
Probability and Statistics						
NLO			1	1	2	10
University	2			3	2	
Number Theory						
NLO		4	8	2		
University	2	4	1			
Logic and Set Theory						
NLO		4	3	2	5	
University	2	1	2	2		
Math Applications						
NLO	1	2	4	4	3	
University	2	2	1	1		1
Informatics						
NLO			2	1	5	6
University	2	2		1	2	

Logic and Set Theory. There appears to be a wide range of opinion as to the importance of this as a course. The requirements range from 0 to 6 semester hours among the NLO respondents. For this topic, perhaps more than many others, important ideas may be covered in other courses. Where this is so, a separate and distinct course becomes unnecessary.

Math applications. This is another area that may often be dealt with in a variety of mathematics courses. Nevertheless, more than half of the responding programs include a course of 1 semester hour or more.

Informatics. This topic receives its heaviest emphasis in the NLO's, with most of them giving a minimum of a 6 semester hour course. At the time of this survey the commonly used terminal was an interactive one connected to the associate university's main computer. Key punches and card readers were also generally available.

D. The items in this group deal with your evaluation of the adequacy of the content background offered by this program.

32. The students in this program have _____ background in mathematics for the courses they will be expected to teach. (Fill in the blank from the given list.)

a) not enough b) adequate c) much more than adequate

If you chose (a), not enough mathematics, indicate below the area(s) in which you feel the weaknesses lie.

This item explores the mathematical adequacy for the teaching job the students will be doing. These responses are personal to the respondent, rather than descriptive of the program, but relate directly to the preceding section. The data for this item are presented in Table NL8.

Table NL8

	NR	Not adequate	adequate	more than adequate
NLO	0	0	9	5
University	0	0	4	3

These data clearly show that the mathematics preparation of Dutch teacher training graduates is perceived as adequate or better. The large number of "more than adequate" responses raises a number of interesting questions regarding program content in individual institutions.

E. This group of items concerns the teaching subjects for which the student is training.

33. Is a second teaching subject (in addition to mathematics) required for teaching certification? (Circle your answer)

YES NO

If your answer to question 33 is YES, please answer questions 34-47. If not, go to section *F*.

For items 34-47 please answer by indicating with an *x* if the listed subjects are available as a second subject with mathematics.

34. ____ astronomy
35. ____ biology
36. ____ chemistry
37. ____ informatics
38. ____ physics
39. ____ other: _____

40. ____ ancient language(s)
41. ____ modern foreign language(s)
42. ____ native language
43. ____ geography
44. ____ economics
45. ____ sociology
46. ____ other: _____
47. ____ history

Among the seven responding Dutch universities only two required a second teaching subject. Level one certification does not require more than one, so that this was clearly instituted by the universities themselves. The responding universities did not indicate which second subjects were available to mathematics students. All NLO's require two teaching subjects in all of their programs. Table NL9 lists the subjects available with mathematics. The questionnaire made no distinction between major and minor subjects and in NLO's both subjects were given equal treatment.

Table NL9

Available Second Subjects - Number Saying Yes

Subject	NLO (N=14)
Astronomy	0
Biology	8
Chemistry	7
Informatics	0
Physics	14
Ancient Language	0
Modern foreign language	2
Native language	5
Geography	7
Economics	7
Sociology	0
History	12
Other	3

Most Dutch NLO's have designated subject combinations which are permissable, physics/mathematics being everywhere available. No particular "others" were indicated. Subjects such as physical education and art are usually taught in other types of institutions.

F. *This set of questions relates to the general professional (non-subject-matter related) educational components of the student's program.*

Are required courses or significant parts of courses devoted to the following areas?

a) YES b) NO c) do not know

48. _____ history of education
49. _____ sociology of education
50. _____ organization/administration of schools
51. _____ general curriculum

This entire section is concerned with general professional areas whether or not they constitute separate courses. While subject matter specialists, such as the responders to these items, sometimes have only imprecise information about the total program, only a few indicated that they were unable to respond. The data for this set of items is shown in Table NL10.

Table NL10

Required Professional Education - Number saying "YES"

	NLO (N=14)	University (N=7)
History of Education	3	1
Sociology of Education	14	3
Administration	8	2
General Curriculum	2	2

Table NL11 summarizes the data from items 52-62 regarding educational psychology requirements and general instructional and school orientational activities. Except for computer assisted instruction all of these areas were attended to in the large majority of institutions. It should be noted that where the rows do not total to 14 and 7 respectively, the respondents noted that these courses were available on an elective basis.

Each of the following items asks for the number of semester hours devoted to a particular area or topic. These items may be answered according to the following scheme:

a) 0 b) 1 c) 2-3 d) 4-6 e) more than 6

52. _____ developmental psychology
53. _____ adolescent psychology
54. _____ motivation
55. _____ learning theories

Table NL11

General Professional Education - Semester Hours Required

	NR	0	1	2-3	4-6	6
Developmental Psychology						
NLO	2		7	3	2	
University		1	4	1		
Adolescent Psychology						
NLO	2		7	1	4	
University	2	1	4			
Motivation						
NLO	2	2	2	8		
University			5	1		
Learning Theory						
NLO	2		4	4	4	
University			5	1		
Microteaching						
NLO	2	1	2	3	4	2
University		2	3	1		
General Instructional Methods						
NLO	3		2	8	1	
University	1	2	3			
Diagnosis and Remediation						
NLO	2	5	3	4		
University	5	1	1			
Audio-Visual Media						
NLO	2		10	2		
University	1	2	3			
School Orientation Visits						
NLO	2	2	5	5		
University	1	2	3			
Individualization						
NLO	2	2	8	2		
University		2	2	2		
Computer Assisted Instruction						
NLO	2	12				
University	5	2				

What is the number of semester hours devoted to each of the following activities in a non-subject-matter setting?

56. _____ microteaching (by whatever approach)
57. _____ general instructional methods
58. _____ diagnostic and remedial teaching
59. _____ audio-visual media familiarization
60. _____ school orientation visits
61. _____ differentiation/individualization
62. _____ computer assisted instruction

G. The items in this set deal with the school practicum experience, i.e. lessons taught in the school setting.

63. In what year of a student's program is the first school practicum experience? (Circle your answer)

    a) 1st b) 2nd c) 3rd d) 4th e) later than 4th

64. Is the school practicum supervision from your institution carried out by someone familiar with mathematics teaching?

    YES NO

65. Does the school practicum time fall within or outside of the time of the regular academic semester?

    a) within b) outside c) other: _____

Section G concerns the practicum in the schools, i.e., student teaching. The time of occurance of the first such experience for the student and the qualifications of the supervisor are the subject of items 63 and 64. The responses to these items are shown in Tables NL12 and NL13 respectively. In the Netherlands all reporting programs indicated that their practica fell within their usual academic semester.

Table NL12

Year of Occurance of First Practicum

	1	2	3	4	later than 4
NLO (N=14)	2	10			
University (N=7)				1	6

Table NL13

Familiarity of Supervisor with Mathematics

	YES	NO
NLO (N=14)	14	
University (N=7)	7	

Thus in Holland all student teaching in Mathematics is supervised by persons familiar with the subject matter.

In order to determine the approximate number of inschool days during student teaching practice, items 66-72 were included. The data as presented were converted to days/year and are shown in this form in Table NL15. The standard program in an NLO is nominally 4 or 4½ years although some students are given extensions. However, no school practicum experiences are provided beyond the fourth year. The evidence in the table clearly indicates that the NLO's get students into schools much more quickly than the universities. In fact, in many of the latter, teacher training is tacked on at the end of a study in mathematics. Thus in the university one studies to become a mathematician first.

Please complete the table below indicating the number of weeks and days per week of the school practicum for each year of a student's program.

	days/week	for	weeks/year
66. year 1	_____		_____
67. year 2	_____		_____
68. year 3	_____		_____
69. year 4	_____		_____
70. year 5	_____		_____
71. year 6	_____		_____
72. beyond year 6	_____		_____

Table NL15

Days of Practicum in each Year by School Type

School	year	days: 0-5	6-20	21-50	50
NLO	1	12	2		
	2	6	8		
	3		5	8	1
	4		3	10	1
University	1	7			
	2	7			
	3	7			
	4	6	1		
	5	1	2	3	1

The remainder of the questionnaire deals with the mathematics teaching methods component of the teacher training program.

73. During what year of a student's program does the first course in mathematics teaching methods appear? (Circle your answer)

a) 1 b) 2 c) 3 d) 4 e) 5 or higher

74. On the reverse side of this sheet list the main textbooks (published or self-constructed) used in your mathematics education courses. Rate the use of each book according to the following scale by placing the appropriate letter next to the listing.

a) used as basis for a course/carefully followed

b) used as basis for a course-partially followed

c) used for occasional reading and written assignments

d) seldom referred to but recommended or required for students

The last two items in section G concern time of occurance of the first teaching methods courses and the textbooks used for such courses. These data are presented in Tables NL16 and NL17 respectively.

Table NL16

	NR	Year: 1	2	3	4	5 or later
NLO (N=14)		10	4			
University (N=7)					1	6

Here as with the practica the NLO's introduce the student early to looking at mathematics in an educational context. The university program in teacher training appears only at the end of the total program. The textbook list does not indicate the level of use since the responses to this aspect were not provided by all responders. The only texts receiving a listing by 6 or more responders were van Hiele, Skemp, and van Dormolen (Didactiek van de Wiskunde). The latter text was listed by twelve programs. Works listed by their own authors and no one else are not included, but it should be fairly recognized that many instructors have developed their own teaching materials which are on high calibre.

Section H deals with the activities and assignments which are part of mathematics education courses and seminars. Table NL18 summarizes the activities included in each respondent's program.

H. Below are listed activities or projects often required of students in mathematics education courses. Please check those which are included in your program.

75. ____ membership in professional organizations
76. ____ attendance at a mathematics teachers' conference
77. ____ analysis of video-taped lessons
78. ____ designing/developing learning packets
79. ____ comparing textbooks and their approaches
80. ____ developing drill and practice exercises
81. ____ developing exercises in problem solving
82. ____ reading articles on curricular issues
83. ____ reading articles or books on theories of learning mathematics
84. ____ other: _____

Table NL17

Textbook Use - Holland

Bakx, G. Praktikum Schoolstof Wiskunde.

Baltink and Bosma: Onwikkeling tot volwassenheid.

Baltink, J. Werken met Groepen.

Chapman, . The Process of Learning Mathematics.

van Dormolen, J. Didaktiek van de Wiskunde.

van Dormolen, J. Vaardigheden.

Freudenthal, H. Mathematics as an Educational Task.

Freudenthal, H. Weeding and Sowing.

Hermans, H. J. M. and Bergen, and Eyssen, K. Van faalangst tot verantwoordelijkheid.

van Hiele, P. M. Begrip en Inzicht.

Holt, J. How Children Fail.

Johnson, D. A. and Rising, G. R. Guidelines for Teaching Mathematics.

Klassikaal vraagstuken oplossen.

Krammer, H. Lesvoorbereiding.

Krutetskii, V. A. The Psychology of Mathematical Abilities in School Children.

van Parreren, C. F. Leren op school.

Skemp, R. Wiskundig denken. (The Psychology of Learning Mathematics).

Wansink, J. H. Didactische orientatie voor Wiskundeleraren.

Zwaneveld, B. and van Dormolen, J. Handelen om te begrijpen.

Table NL18

Activities Included in Mathematics Education Courses by School Type

Activity	NLO (N=14)	University (N=7)
Membership in professional organizations	4	1
Attendance at Math Teachers' Conference	0	0
Analysis of videotaped lessons	14	5
Developing learning packets	14	5
Comparing textbook approaches	14	7
Develop drill and practice exercises	8	3
Develop exercises in problem solving	10	3
Reading articles on curriculum	7	5
Reading articles on theories of learning math	12	5

I. Below are listed topics or areas dealt with directly in the school mathematics classroom. How much attention do you give to the "How to teach" for each of these topics?

a) none b) little c) moderate d) great

85. _____ problem solving
86. _____ concepts
87. _____ methods of proof/logical structure
88. _____ algorithms
89. _____ facts
90. _____ use of the calculator
91. _____ use of the computer
92. _____ applications of mathematics
93. _____ specific mathematical topics
94. _____ other: _____

The data in Table NL19 for section I gives an indication of the relative emphasis given to how to teach various components of the mathematics curriculum.

Table NL19

Emphases given to "How to Teach" selected mathematical topics

Topic and School	NR	None	Little	Moderate	Great
Problem Solving					
NLO	2		2	7	3
University		1	1	2	3
Concepts					
NLO				7	7
University		1		2	4
Proof/Logic					
NLO			8	4	2
University		1	3	2	1
Algorithms					
NLO		1	8	5	
University		1	3	3	
Facts					
NLO		3	8	3	
University		2	5		
Calculator Use					
NLO	2	4	2	5	1
University		4	3		
Computer Use					
NLO		4	2	7	1
University	2	4			1
Applications					
NLO		2	2	5	5
University		1	1	5	
Specific Math Topics					
NLO	3		4	7	
University	1	1	3	1	1

The preceding section dealt with how to teach particular elements or facets of school mathematics. The following section is more concerned with the kinds of things a teacher must do in and outside the classroom in order to carry out his teaching task. These are items often discussed in teaching methods courses. Table NL20 displays the data; immediately following is the actual questionnaire item.

J. The following topics are often discussed in a teaching methods course as areas of concern in helping a teacher with his classroom curriculum and instruction. How much attention do you pay to each of these? (Answer as in part I above)

95. _____ sequencing mathematical content
96. _____ formulating goals
97. _____ questioning techniques
98. _____ selecting and carrying out teaching strategies
99. _____ selecting pupil activities
100. _____ test construction and evaluation
101. _____ diagnosis and remediation
102. _____ computer assisted instruction
103. _____ comparing textbooks
104. _____ how to develop learning packets
105. _____ using concrete materials
106. _____ individualization/differentiation
107. _____ other: _____

Of all of the topics listed in this section only Computer assisted instruction (CAI) receives no attention. This is probably appropriate in view of the lack of CAI in schools, although it is too soon to tell what might happen in the future with the easy availability of microcomputers. One notes also that few topics attract a "great" rating from a large number of programs. Thus a balance between the many important areas is suggested. On the other hand, the "little emphasis" rating of a number of areas raises interesting questions.

Table NL20

Curriculum and Instruction Topics Discussed
in Teaching Methods Course - Emphasis by School Type

	NR	none	little	moderate	great
Sequencing Content					
NLO		1		9	4
University		2		3	2
Formulating Goals					
NLO			6	4	4
University			2	4	1
Questioning Techniques					
NLO	2		4	7	1
University			3	3	1
Teaching Strategies					
NLO			5	5	4
University		1	4	2	
Selecting Pupil Activities					
NLO	2		2	7	3
University		1	3	3	
Test Construction and Evaluation					
NLO	2			12	
University			4	3	
Diagnosis and Remediation					
NLO		1	7	4	2
University		3	2	2	
Computer Assisted Instruction					
NLO	2	12			
University		7			
Comparing Textbooks					
NLO		2	2	7	3
University			2	5	
Developing Learning Packets					
NLO	2			12	
University		1	4	2	
Using Concrete Materials					
NLO			2	8	4
University		1	1	5	
Individualization					
NLO			6	8	
University		1	3	3	

Table NL21

Relative Emphasis on How to Teach Topics in Various Branches of Mathematics

	NR	none	little	moderate	great
Geometry					
NLO		2		7	5
University		2	2	2	1
Algebra					
NLO		2		7	5
University		1	3	3	
Probability					
NLO		2	6	5	1
University		3	2	2	
Statistics					
NLO		4	4	5	1
University		3	2	2	
Trigonometry					
NLO		2	7	5	
University		4	1	2	
Analysis/Calculus					
NLO		5	3	6	
University		3	1	2	1

K. How much attention is paid specifically to how to teach topics in each of the following areas of mathematics? (answer as in part I)

108. ____ geometry
109. ____ algebra
110. ____ probability
111. ____ statistics
112. ____ trigonometry
113. ____ analysis/calculus

Section K concerns the relative emphasis placed on teaching topics in the various branches of mathematics. The data for this section appear in Table NL21. From the data it is evident that algebra and geometry receive the heaviest emphasis in the "how to teach" department. This seems reasonable in view of the fact that the bulk of the secondary school curriculum is devoted to these areas. It also raises a question of what is being done in programs which respond "none" on these two items.

On other topics in the list there is a rather even spread on each from "none" to "moderate", although calculus tends towards these two extremes.

Sections L and M provide an attempt to determine what writers/theoreticians are being read and used in order to provide background and a theoretical basis for the teaching of mathematics. The first of these sections asks in a general way what writings are used, while the second section asks the respondent to associate names of theoreticians to instructional areas. Section L appeared in the questionnaire as follows:

L. In attempting to give a theoretical basis to the teaching of mathematics, to what extent do you draw upon the writings of the following. Please select your response from the list immediately below:

a) do not know the writings
b) know the name, but do not use
c) use the ideas implicitly
d) ideas and name explicitly discussed

114. _____ E. Castelnuovo
115. _____ Z. Dienes
116. _____ A. Engel
117. _____ H. Freudenthal
118. _____ C. Gattengno
119. _____ K. Henderson
120. _____ H. Meschkowski
121. _____ G. & F. Papy
122. _____ G. Polya
123. _____ R. Skemp
124. _____ J. van Dormolen
125. _____ P. van Hiele
126. ____ D. Ausubel
127. ____ B. Bloom (taxonomy)
128. ____ J. Bruner
129. ____ R. Gagne
130. ____ P. Gal'perin
131. ____ L. Landa
132. ____ J. Piaget
133. ____ other: _____
134. ____ other: _____
135. ____ other: _____
136. ____ other: _____
137. ____ other: _____

Items 133 and following gave the respondent the opportunity to name others not on the list. While many took advantage of this opportunity, only a few additional writers were named by more than two respondents and hence these additional names are not included in Table NL22. Ten Dutch responders wrote in IOWO (Instituut Ontwikkeling Wiskunde Onderwijs), indicating the importance of the materials and activities developed by this institute. However, these do not necessarily reflect the work of one theoretician or writer. Perhaps one can assume that much of this material reflects the work and thinking of Freudenthal. Those writers used implicitly or explicitly in a majority of the responding programs include: Freudenthal, Polya, Skemp, van Dormolen, van Hiele, Bloom, Bruner, Galperin, and Piaget.

M. For each of the areas listed below (taken from parts I and J above) indicate the number(s) corresponding to the writer(s) from L upon whom you base your instructional activities. (If none, enter 0)

138. _____ teaching problem solving
139. _____ teaching concepts
140. _____ teaching proof and logical structure
141. _____ teaching algorithms
142. _____ teaching facts
143. _____ sequencing mathematical content

Table NL22
Authors used to provide a basis for teaching mathematics

Writer	School type	NR	Writings Unknown	Known Not Used	Used Implicitly	Used Explicitly
Castelnuovo	NLO	2	3	7	2	0
	University	0	0	5	2	0
Dienes	NLO	2	0	9	3	0
	University	0	0	5	2	0
Engel	NLO	2	1	7	4	0
	University	0	0	3	3	1
Freudenthal	NLO	0	2	0	2	10
	University	0	0	0	2	5
Gattegno	NLO	2	7	5	0	0
	University	1	3	3	0	0
Henderson	NLO	2	10	2	0	0
	University	0	6	1	0	0
Meschkowski	NLO	2	8	2	2	0
	University	0	4	2	1	0
Papy	NLO	2	2	8	2	0
	University	0	0	2	4	1
Polya	NLO	0	0	0	8	6
	University	0	0	0	3	4
Skemp	NLO	0	0	0	2	12
	University	0	0	0	2	5
van Domolen	NLO	0	0	0	2	12
	University	0	0	0	0	7
van Hiele	NLO	0	0	4	0	10
	University	0	0	1	0	6
Ausubel	NLO	2	2	8	2	0
	University	0	0	2	4	1
Bloom	NLO	2	0	6	2	4
	University	0	0	1	1	5
Bruner	NLO	2	1	5	6	0
	University	0	0	2	4	1
Gagne	NLO	2	0	10	2	0
	University	0	0	2	4	1
Galperin	NLO	0	2	0	9	3
	University	0	0	1	2	4
Landa	NLO	2	7	5	0	0
	University	0	0	5	1	1
Piaget	NLO	2	0	2	4	6
	University	0	0	1	3	3

TABLE NL23
Writers/Theoreticians used for Teaching Specified Topics

	Topics												
	138	139	140	141	142	143	144	145	146	147	148	149	150
No response	3	2	9	9	15	4	4	12	3	11	14	17	13
Castelnuovo	2	0	0	0	0	0	0	0	0	0	0	0	4
Dienes	1	2	0	0	0	0	0	0	0	0	0	0	0
A. Engel	1	2	0	2	0	2	0	0	0	0	0	0	0
Freudenthal	0	5	8	3	0	4	1	0	0	0	2	0	4
Gattengo	0	0	0	0	0	0	0	0	0	0	0	0	0
Henderson	0	0	0	0	0	0	0	0	0	0	0	0	0
Meschkowski	0	2	0	0	0	0	0	0	0	0	0	0	0
G & F Papy	0	0	0	0	0	0	0	0	0	0	0	0	0
Polya	22	0	0	0	0	0	0	2	1	0	0	0	0
Skemp	0	21	1	1	2	5	0	0	5	1	0	0	0
van Dormolen	1	14	4	8	7	17	13	7	16	6	1	5	6
van Hiele	0	14	4	1	1	5	1	1	8	4	0	0	2
Ausubel	0	0	1	0	3	1	0	0	2	0	0	0	0
Bloom	0	0	0	0	2	0	11	0	0	0	6	2	0
Bruner	1	1	0	0	0	2	2	0	1	0	0	0	0
Gagne	0	0	1	0	0	3	0	0	0	0	0	0	0
Galperin	1	5	1	6	0	4	0	0	6	2	0	1	0
Landa	3	0	0	3	0	0	0	0	0	0	0	0	0
Piaget	1	5	1	0	0	0	0	0	0	0	0	0	0

144. _____ formulating goals
145. _____ questioning techniques
146. _____ explication of teaching strategies
147. _____ selecting an appropriate teaching strategy
148. _____ test construction and evaluation
149. _____ diagnosis and remediation
150. _____ selecting pupil activities
151. _____ other: _____
152. _____ other: _____

There was a high level of nonresponse for many of these items, more than 50% in some cases. Multiple responses were permitted and thus the totals for each column are variable. The data are shown in Table NL23.

The well known works of van Dormolen and van Hiele are widely used in many aspects of the teacher training programs. Note the high rating of both writers on teaching concepts, sequencing content, and teaching strategies. If we assume that 5 (N=21) or more responses on a particular topic is a significant indication of the extent to which an author is used, then we can summarize the data in this table as having the following uses as significant:

Freudenthal on teaching concepts, proof and logical structure

Polya on problem solving

Skemp on teaching concepts, sequencing content, explication of teaching strategies

van Hiele on teaching concepts, sequencing content, explication of teaching strategies

Bloom on formulating goals, test construction and evaluation

Galperin on teaching concepts, teaching algorithms, explication of teaching strategies

Piaget on teaching concepts

van Dormolen on <u>all</u> (except: teaching problem solving, proof and logical structure, test construction and evaluation)

One must assume here that "use" probably for most respondents meant a conscious, explicit reference to the writing of the author/theoretician. Nothing here suggests that a low rating for a particular writer means that his ideas are not used implicitly.

Sections N and P of the questionnaire were open ended items, some of which required respondents' opinions and judgments. Before treating these sections, Section O will be presented. It consisted of the following checklist of credentials required by teacher training institutions for their own instructors in mathematics education.

O. In the following set of items check those credentials or requirements which are required by your department or institution for instructors in mathematics education.

155. _____ Doctorate in mathematics
156. _____ Doctorate in mathematics education
157. _____ Either one of the above doctorates
158. _____ Completed university study of mathematics, but no thesis
159. _____ No explicit training in mathematics
160. _____ Other mathematical training: _____
161. _____ Classroom teaching experience: _____
162. _____ Explicit university level training in pedagogy, didactics, or education
163. _____ None of the above
164. _____ Other: _____

In a hiring situation, it is clear that any institution has "requirements," but it is also normally understood that these are not hard and fast rules and that a candidate's background and experience, taken as a whole, are what count. The data presented in Table NL24 should be viewed in this light.

Table NL24

Credentials Required of Mathematics Education Staff

Requirement	NLO (N=14)	University (N=7)
doctorate in mathematics	0	1
doctorate in mathematics education	0	0
either in above doctorates	0	0
completed university study of math (drs)	14	6
no explicit training in math	0	0
other mathematical training	8	0
classroom teaching experience	4	5
university training in pedagogy	0	2

The primary requirement for mathematics education positions in teacher training is completion of university training in mathematics. This is roughly equivalent to the North American "all but dissertation," i.e., work to the level of a doctorate, including comprehensive examinations, but omitting the doctoral thesis. Thus this is the same mathematical training required for the Level I certificate. The only real alternative is completion of an evening school program to the equivalent level. Classroom teaching experience is not considered an absolute requirement by the majority of reporting programs.

Replies in Sections N and P were permitted in either Dutch or English and of the 15 individuals and 21 programs responding, 6 did so in English, 9 in Dutch. Items 153-154 (four items due to a numbering error in the questionnaire) ask for judgments about the respondent's own program(s).

N. The following items are evaluative in nature. Please feel free to give expanded responses where appropriate. You may respond in legible English, Dutch, or German.

153. What do you see as the major weaknesses or areas of concern within your program? Rank order these items.

This item generated almost as many different responses as responders. The most common complaints fell into two general related categories: 1) too little school practicum, and 2) a concern for the integration of theory and practice. In fact, virtually all of the concerns (except the general "not enough time") could easily be placed in this second category. While some responders emphasized the concern for practical pedagogy, others phrased their response in terms of mathematics - making it relevant for the pupils in the school classroom. One writer raised a more general question:

> Een opleiding die de pretentie heeft "geprofessionaliseerd" te zijn, brengt het gevaar met zich, dat veel tijd geinvesteerd wordt in het nastreven van doelstellingen, die wellicht niet in belangrijke mate bereikt kunnen worden op een initiele opleiding.*

The NLO goal of professionalization through integration of subject matter learning and pedagogical training is clearly stated (e.g. Inventariserend Onderzoek..., 1976; Voortgezet Onderzoek..., 1979). It is clear from the questionnaire responses as well as these summary reports that this is a continuing concern, but at the same time an area to which many instructors and institutions are devoting effort and, from my own personal observations, making real progress.

The writer of the above comment recognizes the need for continuing education. A similar concern is expressed by others in Section P of the questionnaire and by those in universities anticipating changes and expansion in their programs.

Only one responder questioned the mathematics background of students and the concern was their insecurity with the mathematics of the school curriculum, not mathematics per se. The major concern with respect to mathematics was the ability of students to deal with it at the school level.

152. What do you see as the most important didactical aspects of your program for training mathematics teachers?

---

*"A training program which has pretentions of being 'professionalized,' carries with it the danger that much time will be invested in striving for goals which perhaps cannot be attained to any important extent in an initial training."

The most commonly mentioned aspect here was the goal of developing a professional attitude toward mathematics teaching. A few programs mentioned as important to their own situation the integration of theory and practicum that they have achieved. One responder mentioned that in his program students did not begin with theory which they then attempted to apply, but rather began with practice and practical situations and worked back to relevant theory. Several others mentioned their emphasis on self evaluation and examination as a step toward improvement and change.

153. Do you see any strong tendencies to change in your program in the near future (3 to 5 years)? If YES, briefly describe them.

About half of the responders anticipated changes in the near future, while several more indicated that discussions were in progress which might lead to changes. Many indicated anticipation of changes which would provide stronger links between the school practicum and the theoretical work. More than half of the university responders expected that there would be an expansion of the time available in their programs. Such time would be largely (or even entirely) used for teacher training purposes rather than further study in mathematics.

154. Have you ever surveyed the graduates of your program or their employers to determine what they see as the major strengths and weaknesses?

a) YES b) NO c) Survey now in progress

If YES, what aspects of the program were mentioned most? By whom?

Strengths	Weaknesses

More than half answered "NO" here and three indicated some sort of formal survey in progress. While no one circled YES, several did point out that although formal surveys do not take place, they continually talk informally with former students in schools, in evening courses, at "terugkomdagen," and so on. These discussions do influence program decisions. One responder suggested that reports from former students were so conflicting as to be useless.

Section P is concerned with continuing, or inservice, education.

P. The questionnaire up to this point has concerned itself with the educational program required to gain the necessary initial certificate or teaching credentials in order to teach mathematics in a secondary school. Beyond this, further education and professional development may be available to the practicing teacher.

165. What further education, if any, in either mathematics or education, is required by state authorities to maintain appropriate professional status?

In the Netherlands no further education beyond the initial teaching certificate is required by law.

166. What further formal or informal courses or workshops, presented by educational institutions, ministry of education officials, or professional organizations are available to the professionally interested teacher? Briefly describe such activities and their sponsorship.

Several types of opportunities were mentioned in response to this item, the most common one being the A-B-C courses offered from time to time by the NVWL (Nederlandse Vereniging van Wiskundeleraren). Next most frequently mentioned were the courses and workshops offered by IOWO (Instituut Ontwikkeling Wiskunde Onderwijs), unfortunately now past history. In addition, the opportunities provided by the NLO's and the evening schools were noted. As several responders also wrote, the situation in this area is changing.

167. When new curriculum is introduced into the schools, what updating opportunities are available to teachers?

Those opportunities mentioned in the preceding item were repeated here with the comment that there is little in the way of a large-scale systematized updating scheme.

168. If possible, identify one or two of what you regard as the major questions or problems facing mathematics teacher education today.

The concern for the integration of theory and practice was raised here again by several responders. One mentioned the demise of IOWO, while another (university person) said the "outmoded Dutch law for teacher training." Many left this one blank.

The final two items may be considered together.

169. Would you be interested in receiving a summary of the report of this survey?

170. Would you be willing to discuss your program further with this investigator in a personal conversation?

The vast majority of responders indicated interest in the results and willingness to discuss their programs. In fact, all but one responded YES to both of these queries.

A SURVEY OF SECONDARY MATHEMATICS TEACHER TRAINING PRACTICES IN WEST GERMANY AND THE NETHERLANDS

Summary of Dutch Results

Completed questionnaires were returned by 15 (out of 17) university and NLO* instructors representing a total of 21 programs of study and most of the institutions in Holland which have full time teacher training. Programs varied in size from three (1 university and 2 NLOs) which had over 50 graduates per year to four NLOs which had less than 10. Virtually all university students had completed atheneum, while NLO students came from a much wider variety of backgrounds. The majority of NLO students had gone to the havo, although most programs indicated that a small proportion of mavo students were also admitted.

Linear algebra and analysis/calculus were given considerable emphasis in all of the surveyed programs. Geometry was given greater stress by the NLOs than by the universities and the former also gave moderate to great emphasis on how to teach geometry. Probability and statistics was included in all programs. Informatics and computers received high emphasis at the NLO, but generated relatively little activity at the university. Respondents for 8 out of the 21 programs indicated that they felt that the mathematical background of graduates was more than adequate, and the rest found it adequate. Most university programs require only one teaching area (mathematics) while two are mandated at the NLOs. The second teaching subject available to mathematics students varied, but physics was available at all NLOs and history at most of them.

In the area of general courses in education, all of the NLOs and half of the university programs required some work in what might be called the "Sociology of Education." In the areas of developmental and adolescent psychology and learning theory most programs required one semester hour or more of work. In general, more of such work was required in the NLO programs.

Some school practicum work has begun for all NLO students by the second year of their study, whereas for university students it seldom begins before year 5. The total amount of practicum time in the final year of study is similar for the two institutions, but the greater school experience in the earlier years gives the edge to the NLOs.

When activities included in mathematics education courses are listed, the proportions of programs indicating inclusion of the activity are not dissimilar for the two types of institutions. Both give moderate to great emphasis on teaching concepts, problem solving, and applications. More emphasis is given to calculators and computers by the NLO programs. The sequencing of mathematical content is given emphasis by all. More NLOs give attention to test construction and evaluation and to developing learning packets. In general, a greater proportion of NLO programs give moderate to great

emphasis to instructional methods and techniques of various sorts.

There was much less difference in the emphases placed on how to teach topics in various branches of mathematics--here patterns were similar in the two types of programs. Among writers referred to as a basis for instruction, the following were considered significant in that at least 25% made the identification:

Freudenthal on teaching concepts, proof, and logical sturcture.
Polya on problem solving.
Skemp on teaching concepts, sequencing content, teaching strategies.
van Hiele on teaching concepts, sequencing content, teaching strategies.
Bloom on formulating goals, test construction and evaluation.
Galperin on teaching concepts and algorithms, teaching strategies.
Piaget on teaching concepts.
van Dormolen on ALL (except: problem solving, proof and logical structure, test construction and evaluation).

These results were similar across all programs.

Universally these programs expected their staff to have completed university training (drs) in mathematics, but only 4 out of 14 NLOs and 5 out of 7 universities expected instructors to have classroom teaching experience.

Many respondents saw a major goal as helping students to develop a professional attitude toward the teaching of mathematics. The most commonly mentioned concerns about programs were: 1) too little school practicum, and 2) the integration of theory and practice. While some responders emphasized the concern for practical pedagogy, others phrased their response in terms of mathematics - making it relevant for the pupils in the school classroom.

---

*Nieuwe Lerarenopleiding - Teachers' College

IV. CONCLUDING REMARKS

Obvious similarities occur between programs in the two countries with regard to mathematics requirements. Analysis/calculus, linear algebra, and geometry receive considerable attention in both, while the stress on informatics varies by country and institution. Dutch university students are not often required to have a second teachable subject in addition to mathematics, but all other programs do require this.

Relative emphasis given to various aspects of curriculum (Tables 11 and 20) does not appear to vary greatly, although microteaching is somewhat more used in the Dutch NLO setting than elsewhere.

The selection of writers to whom instructors look for a theoretical basis for their work varied within each country, but even more greatly between the two countries. Of those indications which were considered significant, four were held in common:

1) Freudenthal on teaching proof and logical structure
2) Polya on problem solving
3) Bloom on formulating goals
4) Piaget on teaching concepts.

On the other hand, some writers from third countries were recognized in one and not the other. For example, Skemp's (The Psychology of Learning Mathematics) work appears to be well known and widely used in Holland, while it is clearly less well known in Germany. Henderson's work, on the other hand, is virtually unknown in Holland. The work of the Dutch writers van Dormolen and the van Hieles is also apparently known and respected among the German educators.

Among current concerns about programs in both countries, the role and nature of the school practicum ranks at the top of the list. There was strong feeling that there is too little in-school experience and in some cases (especially Dutch universities) that it comes too late. Where it should be placed, its actual duration, and the nature and role of the cooperating teacher and the supervisor had less clear answers.

References

Aviv, C. A. and Cooney, T. J. Results of a Questionnaire on Secondary Mathematics Teacher-Education Programs. The Mathematics Teacher, 1979, 72 (7), 530-536.

Didaktik der Mathematik: Verzeichnis der an den Hochschulen tätigen Wissenschaftler. 12. Bundestagung für Didaktik der Mathematik, in Münster (Westfalen), 1978.

Eggerer, W. and Feurer, B. Schul-Lexikon für Eltern und Schüler. München: Manz Verlag, 1975.

Freudenthal, H. Weeding and Sowing: Preface to a Science of Mathematical Education. Dordrecht/Boston: D. Reidel, 1978.

Geerligs, T. School, Schoolsysteem, Onderwijsvernieuwing. Harderwijk: 1976, mimeographed.

Inventariserend Onderzoek Nieuwe Lerarenopleiding: Samenvattend Rapport. Den Haag: Staatsuitgeverij, 1977.

Overview and Analysis of school Mathematics grades K-12. Washington, D. C.: Conference Board of the Mathematical Sciences, National Advisory Committee on Mathematics Education (NACOME), November 1975.

Overzichtsrapport: Zes jaar NLO-Onderzoek. Nijmegen/Amsterdam: Nijmeegs Instituut voor Onderwijsresearch/Stichting Centrum voor Ondewijsonderzoek, September 1981.

Rasing, A. F. Samenvatting van een enquête over de lerarenopleiding. Weekblad voor Leraren bij het Voorgezet Onderwijs, 1979, 12 (5), 172-174.

Smith, B. O. (Ed.) Research in Teacher Education. Englewood Cliffs, N. J.: Prentice-Hall, 1971.

Smith, B. O. Teacher Education in Mathematics. Columbus, Ohio: ERIC Center for Science, Mathematics and Environmental Education, The Ohio State University, 1976.

Studien- und Berufswahl 1980/81. Published by Bund-Länder-Kommission für Bildungsplanung und Forschungsförderung und Bundesamt für Arbeit. Bad Honnef, W. Germany: Verlag Karl Heinrich Bock, 1980.

Vademecum voor de Wiskundeleraar (Edited by the directors of the Nederlandse Vereniging van Wiskundeleraren). Groningen: Wolters-Noordhoff, 1977.

van Dormolen, J. Didactiek van de Wiskunde. Utrecht: Costhoek's Uitgeversmaatschappij, 1974.

APPENDIX A

The Questionnaire

SURVEY OF SECONDARY SCHOOL MATHEMATICS TEACHER TRAINING D_____

A. Basic Information

1. Your name and title:_____

2. Your major function:_____

3. Name of Institution:_____

4. Address:_____

_____

5. Telephone numbers: home_____office_____

Definition: The terms *student program* and *program of studies* will be used to refer to the total course of study at the tertiary level which leads to certification to teach mathematics in secondary schools.

N.B. If, in your institution, there are different programs of study leading to different levels of certificate, please complete a separate questionaire for each level. Additional copies of the questionaire may be obtained by photocopying this one or by requesting copies from the investigator.

B. The following questions concern basic information about the size and scope of your program.

6. If your state ("Land") has more than one level of certification for secondary school mathematics teachers, please fill in the blanks in in the following sentence:

The program of studies covered by this questionaire leads to teacher certification at level_____(from the top) of_____levels.

At what school levels and in what programs will your graduates be legally permitted to teach? (Circle the total pupil years in school in each case)

7. Gymnasium	5	6	7	8	9	10	11	12	13
8. Realschule	5	6	7	8	9	10	11	12	
9. Hauptschule	5	6	7	8	9	10	11	12	
10. Volksschule	5	6	7	8	9	10			

What percentage of your entering students have completed each of the following types of secondary school?

11._____Gymnasium

12._____Realschule

13._____other:_____

14._____other:_____

SURVEY OF SECONDARY SCHOOL MATHEMATICS TEACHER TRAINING NL___

A. Basic Information

1. Your name and title:_____

2. Your major function:_____

3. Name of Institution:_____

4. Address:_____

_____

5. Telephone numbers: home_____office_____

Definition: The terms *student program* and *program of studies* will be used to refer to the total course of study at the tertiary level which leads to certification to teach mathematics in secondary schools.

N.B. If, in your institution, there are different programs of study leading to different levels of certificate, please complete a separate questionaire for each level. Additional copies of the questionaire may be obtained by photocopying this one or requesting copies from the investigator.

B. The following questions concern basic information about the size and scope of your program.

6. If your country has more than one level of certification for secondary school mathematics teachers, please fill in the blanks in the following sentence:

The program of studies covered by this questionaire leads to teacher certification at level _____ (from the top) of _____ levels.

At what school levels and in what programs will your graduates be legally permitted to teach? (Circle the total years in school in each case)

7. atheneum/gymnasium	7	8	9	10	11	12	13
8. havo	7	8	9	10	11		
9. mbo	7	8	9	10	11	12	13
10. lbo	7	8	9	10			

What percentage of your entering students have completed each of the following types of secondary school?

11._____ atheneum/gymnasium

12._____ havo

13._____ mbo

14._____ other:_____

15. What is the total (elementary and secondary) minimum number of years of schooling required for entrance into your mathematics teacher training program?

a) 10 b) 11 c) 12 d) 13 e) not specified

16. How many years of full time study at the tertiary level are normally required for certification? (Circle your response)

a) 2 b) 3 c) 4 d) 5 e) 6 or more

17. Circle the average yearly number of graduates over the past three years:

a) 0-10 b) 11-25 c) 26-50 d) 51-75 e) greater than 75

18. What percent of your entering students fail to complete the teacher training program successfully?

a) less than 10 b) 10-20 c) 21-30 d) 30-40 e) greater than 40

19. Give an estimate of the percentage of your graduates who are now teaching:

a) less than 40 b) 40-60 c) 61-80 d) 81-100 e) do not know

C. The following items ask for the minimum number of semester hours required in various areas of mathematics over the total duration of the training program. (1 semester hour = 1 hour per week for 12-15 weeks) For each item place the appropriate letter from the list of hours below:

a) 0 b) 1 c) 2-3 d) 4-6 e) more than 6

20._____analysis/calculus

21._____geometry

22._____linear algebra

23._____modern algebra

24._____topology

25._____numerical methods

26._____probability & statistics

27._____number theory

28._____logic/set theory

29._____mathematical applications

30._____computers/informatics

31._____other:_____ _____

D. The items in this group deal with your evaluation of the adequacy of the content background offered by this program.

32. The students in this program have _____ background in mathematics for the courses they will be expected to teach. (Fill in the blank from the given list.

a) not enough b) adequate c) much more than adequate

If you chose (a), not enough mathematics, indicate below the area(s) in which you feel the weaknesses lie.

E. This group of items concerns the teaching subjects for which the student is training.

33. Is a second teaching subject (in addition to mathematics) required for teaching certification? (Circle your answer)

YES NO

If your answer to question 33 is YES, please answer questions 34-47. If not, go to section *F*.

For items 34-47 please answer by indicating with an *x* if the listed subjects are available as a second subject with mathematics.

34._____astronomy

35._____biology

36._____chemistry

37._____informatics

38._____physics

39._____other:_____

40._____ancient language(s)

41._____modern foreign language(s)

42._____native language

43._____geography

44._____economics

45._____sociology

46._____other:_____

47._____history

F. This set of questions relates to the general professional (non-subject-matter related) educational components of the student's program.

Are required courses or significant parts of courses devoted to the following areas?

a) YES b) NO c) do not know

48._____ history of education

49._____ sociology of education

50._____ organization/administration of schools

51._____ general curriculum.

Each of the following items asks for the number of semester hours devoted to a particular area or topic. These items may be answered according to the following scheme:

a) 0 b) 1 c)2-3 d) 4-6 e) more than 6

52._____developmental psychology

53._____adolescent psychology

54._____motivation

55._____learning theories

What is the number of semester hours devoted to each of the following activities in a non-subject-matter setting?

56._____microteaching (by whatever approach)

57._____general instructional methods

58._____diagnostic and remedial teaching

59._____audio-visual media familiarization

60._____school orientation visits

61._____differentiation/individualization

62._____computer assisted instruction

G. The items in this set deal with the school practicum experience, i.e. lessons taught in the school setting.

63. In what year of a student's program is the first school practicum experience? (Circle your answer)

a) 1st b) 2nd c) 3rd d) 4th e) later than 4th

64. Is the school practicum supervision from your institution carried out by someone familiar with mathematics teaching?

YES NO

65. Does the school practicum time fall within or outside of the time of the regular academic semester?

a) within b) outside c) other:_____

Please complete the table below indicating the number of weeks and days per week of the school practicum for each year of a student's program.

	days/week	for	weeks/year
66. year 1	_____		_____
67. year 2	_____		_____
68. year 3	_____		_____
69. year 4	_____		_____
70. year 5	_____		_____
71. year 6	_____		_____
72. beyond year 6	_____		_____

The remainder of the questionaire deals with the mathematics teaching methods component of the teacher training program

73. During what year of a student's program does the first course in mathematics teaching methods appear? (Circle your answer)

a) 1 b) 2 c) 3 d) 4 e) 5 or higher

74. On the reverse side of this sheet list the main textbooks (published or self-constructed) used in your mathematics education courses. Rate the use of each book according to the following scale by placing the appropriate letter next to the listing.

a) used as basis for a course/carefully followed

b) used as basis for a course/partially followed

c) used for occasional reading and written assignments

d) seldom referred to but recommended or required for students

H. Below are listed activities or projects often required of students in mathematics education courses. Please check those which are included in your program.

75._____membership in professional organizations

76._____attendance at a mathematics teachers' conference

77._____analysis of video-taped lessons

78._____designing/developing learning packets

79._____comparing textbooks and their approaches

80._____developing drill and practice exercises

81._____developing exercises in problem solving

82._____reading articles on curricular issues

83._____reading articles or books on theories of learning mathematics

84._____other:_____

I. Below are listed topics or areas dealt with directly in the school mathematics classroom. How much attention do you give to the "How to teach" for each of these topics?

a) none b) little c) moderate d) great

85._____problem solving

86._____concepts

87._____methods of proof/logical structure

88._____algorithms

89._____facts

90._____use of the calculator

91._____use of the computer

92._____applications of mathematics

93._____specific mathematical topics

94._____other:_____

J. The following topics are often discussed in a teaching methods course as areas of concern in helping a teacher with his classroom curriculum and instruction. How much attention to you pay to each of these? (Answer as in part I above)

95._____sequencing mathematical content

96._____formulating goals

97._____questioning techniques

98._____selecting and carrying out teaching strategies

99._____selecting pupil activities

100._____test construction and evaluation

101._____diagnosis and remediation

102._____computer assisted instruction

103._____comparing textbooks

104._____how to develop learning packets

105._____using concrete materials

106._____individualization/differentiation

107._____other:_____

K. How much attention is paid specifically to how to teach topics in each of the following areas of mathematics? (Answer as in part I)

108._____geometry

109._____algebra

110._____probability

111._____statistics

112._____trigonometry

113._____analysis/calculus

L. In attempting to give a theoretical basis to the teaching of mathematics, to what extent do you draw upon the writings of the following. Please select your response from the list immediately below:

a) do not know the writings
b) know the name, but do not use
c) use the ideas implicitly
d) ideas and name explicitly discussed

114._____E. Castelnuovo
115._____Z. Dienes
116._____A. Engel
117._____H. Freudenthal
118._____C. Gattengno
119._____K. Henderson
120._____H. Meschkowski
121._____G. & F. Papy
122._____G. Polya
123._____R. Skemp
124._____J. van Dormolen
125._____P. van Hiele
126._____D. Ausubel
127._____B. Bloom (taxonomy)
128._____J. Bruner
129._____R. Gagné
130._____P. Gal'perin
131._____L. Landa
132._____J. Piaget
133._____other:_____
134._____other:_____
135._____other:_____
136._____other:_____
137._____other:_____

M. For each of the areas listed below (taken from parts I and J above) indicate the number(s) corresponding to the writer(s) from L upon whom you base your instructional activities. (If none, enter 0)

138._____teaching problem solving
139._____teaching concepts
140._____teaching proof and logical structure
141._____teaching algorithms
142._____teaching facts
143._____sequencing mathematical content
144._____formulating goals
145._____questioning techniques
146._____explication of teaching strategies
147._____selecting an appropriate teaching strategy
148._____test construction and evaluation
149._____diagnosis and remediation
150._____selecting pupil activities
151._____other:_____
152._____other:_____

N. The following items are evaluative in nature. Please feel free to give expanded responses where appropriate. You may respond in legible English, Dutch, or German.

153. What do you see as the major weaknesses or areas of concern within your program? Rank order these items.

152. What do you see as the most important didactical aspects of your program for training mathematics teachers?

153. Do you see any strong tendencies to change in your program in the near future (3 to 5 years)? If YES, briefly describe them.

154. Have you ever surveyed the graduates of your program or their employers to determine what they see as the major strengths and weaknesses?

a) YES b) NO c) Survey now in progress

If YES, what aspects of the program were mentioned most? By whom?

Strengths	Weaknesses

O. In the following set of items check those credentials or requirements which are required by your department or institution for instructors in mathematics education.

155._____Doctorate in mathematics

156._____Doctorate in mathematics education

157._____Either one of the above doctorates

158._____completed university study of mathematics, but no thesis

159._____No explicit training in mathematics

160._____other mathematical training:_____

161._____classroom teaching experience:_____

162._____explicit university level training in pedagogy, didactics, or education.

163._____None of the above.

164._____other:_____

P. The questionaire up to this point has concerned itself with the educational program required to gain the necessary initial certificate or teaching credentials in order to teach mathematics in a secondary school. Beyond this, further education and professional development may be available to the practicing teacher.

165. What further education, if any, in either mathematics or education, is required by state authorities to maintain appropriate professional status?

166. What further formal or informal courses or workshops, presented by educational institutions, ministry of education officials, or professional organizations are available to the professionally interested teacher? Briefly describe such activities and their sponsorship.

167. When new curriculum is introduced into the schools, what updating opportunities are available to teachers?

168. If possible, identify one or two of what you regard as the major questions or problems facing mathematics teacher education today.

169. Would you be willing to discuss your program further with this investigator in a personnal conversation?

170. Would you be interested in receiving a summary of the report of this survey?

APPENDIX B

Cover Letters

UM

The University of Manitoba
Faculty of Education

Department of Curriculum
Mathematics and Natural Sciences

Winnipeg, Manitoba, Canada R3T 2N2

Coronastraat 22
9742 EG Groningen
Netherlands
tel: 050-779129

1 February 1980

Dear Colleague:

Accompanying this letter is a questionaire dealing with educational programs designed to prepare teachers for secondary school mathematics. Similar versions have been sent to selected mathematics educators in Belgium, Germany, and Holland.

The investigation of which this questionaire is a part is a study of mathematics teacher training supported by the University of Manitoba as part of my sabbatical year activities in Europe. I hope that you will take the time to complete it carefully and, if you wish, to make comments on its content and/or form. Furthermore, as indicated in one of the final items, if you are interested and willing to discuss your program further with me, I would be happy to try to arrange to do so.

Most of you receiving this questionaire have been recommended by one or more of your colleagues as interested and knowledgeable about your teacher training programs. Because of the small, select sample the success of this endeavor depends in large measure on completion of the questionaire by all recipients. If you have questions or would like further information, please feel free to write or telephone me at my Dutch address. Your anonymity will be respected and no personal names will appear in the final report without permission.

Thank you in advance for your help in this investigation. To those whom I have already met and with whom I have discussed this project--greetings! To others likewise greetings in the hope that I may someday soon have the pleasure of meeting you.

Sincerely yours,

Lars Jansson

Lars C. Jansson
Professor, Mathematics Education
University of Manitoba
Winnipeg, Manitoba, Canada

Please return by March 15, 1980

The University of Manitoba
Faculty of Education

Department of Curriculum
Mathematics and Natural Sciences

Winnipeg, Manitoba, Canada R3T 2N2

Aan de Nederlandse NLO's:

U vindt hierbij twee exemplaren van de enquête ingesloten--een voor het 2e graads en een voor het 3e graads programma. U hoeft niet de 2e graads enquête volledig in te vullen, maar alleen voor zover deze verschilt van de 3e graads enquête. Vergeet u niet uw naam en uw instituut te vermelden op beide formulieren.

Met dank voor uw medewerking.

Lars C. Jansson

P.S. Dit houdt in dat tenminste de volgende vragen beantwoord moeten worden op beide formulieren:

1,3,6-17